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FRG: CONCEPT PAPER ON MICROELECTRONICS, COMMUNICATIONS TECHNOLOGY

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WEST EUROPE REPORT

SCIENCE AND TECHNOLOGY

FRG: CONCEPT PAPER ON MICROELECTRONICS, COMMUNICATIONS TECHNOLOGY

Bonn INFORMATIONSTECHNIK in German 1984 pp 1-80

[Introduction, table of contents, summary and text of report issued by Minister of Research and Technology of Federal Republic of Germany]

[Text] Introduction

The production, processing and distribution of information in modern industrial society is increasingly taking on the role of an independent factor of production next to capital and labor. Precisely because the FRG is a nation with a strong export orientation the capability to develop and apply with an eye to the market modern information and communication technologies and microelectronics which provides the basis for them has a very important bearing on our competitive position.

For this reason, the FRG must try to attain a leadership position in information technology.

This is a possibility provided that the men and women of the FRG take up the challenge of this technology--in terms of training and continuing education as well as in the media and in public life; that industry aggressively seeks out markets and engages in international competition and that the state removes existing obstacles and creates the kind of conditions that will make its assistance programs most effective.

In his 4 May 1983 government statement, Chancellor Dr Helmut Kohl announced a comprehensive government concept to assist development in microelectronics adn the information and communication technologies. This concept is not limited to assistance to the technological sector alone but was worked out under the leadership of the ministry for research and technology with the help of other ministries and includes their contributions.

This overall concept was adopted by the cabinet on 14 March 1984. The programs outlined are a reflection of the government's resolve to meet the challenge of information technology and to help improve the FRG's competitive position in this field. In this endeavor, it pins its hopes on the dynamism and innovative capacity of German industry and places its faith in the readiness of those who are a part of our market economy to learn and to work hard and in the willingness of all participants to work as partners.

/s/ Dr Heinz Riesenhuber, Minister for Research and Technology

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I. Summary

FRG: A Concept Paper for Microelectronics and Communications Technology

The ability to develop up-to-date information and communication technology as well as microelectronics which provides the basis for these in time and to make them marketable is a major factor affecting the competitive position of highly industrialized societies.

One important precondition is an efficient information technology industry. But this is not the only reason why international competition on these markets is intensifying but also because there is a realization that information technology is a growth industry worldwide which should continue to grow for some time at a faster pace than many other industries.

The well-being of our society depends to a large extent on the competitiveness of our economy. The challenge posed by information technology must therefore be met. The outlook for information technology must be analyzed soberly with a view to securing our economy for the future without at the same time losing sight of the social problems.

There are some areas in which the German information technology industry is a world leader. But it is of some concern to the FRG government that the competitive position of German information technology is in danger in the microelectronics field as well as in some areas of data processing because of the worldwide efforts being made in these fields although it still enjoys a rather favorable position technologically.

The various branches of information technology are interrelated and there is a close mutual relationship between them. In the long run, for example, there can be no successful communication technology industry without an efficient data processing industry. And without microelectronics, there can be no long-range progress in either the data processing or the communication technology industry.

There is an intense international competition in information technology which forces the FRG industry to make special efforts. For one thing, the German market is relatively small for domestic suppliers and for another, the information technology industry of the major competitor countries receives a wide variety of overt and covert government assistance. In the United States, for example, this assistance has its source in publicly funded weapons technology research and development and in Japan in the close cooperation between the government, industry and publicly funded research.

As announced in the May 1983 government declaration, the FRG government herewith submits a comprehensive concept for a program to develop microelectronics as well as information and communication technology. In this document, the government re-emphasizes its resolve to meet the challenge of information technology and to improve the FRG's competitive position in information technology. To achieve this, it pins its hopes on the German

economy's inherent dynamism and innovative potential. These measures which are part of the overall economic policy of the FRG government are designed to create the kind of conditions which will enable the German information technology industry to take advantage of the opportunities afforded by the worldwide information technology markets of the future. Assistance will, on the one hand, consist in bringing a wide variety of indirect measures to bear to a greater extent than in the past. On the other hand, the measures are designed to cluster the limited research and developmtne resources in our country and to apply R and D findings in a more efficient manner.

After careful analysis, the FRG government has decided on a concept which provides for measures in five main areas:

1. General improvement of market economy conditions and, as a consequence, of the competitive position of the FRG and of Europe with special emphasis on venture capital, market openings and innovation-oriented public procurement.

2. Motivating people to meet the technological challenge by providing information on options for the future and by intensified education in the information and communication technology field.

3. Activation of innovation-oriented markets by means of a future-oriented buildup of the communication infrastructure and innovation in the end equipment field.

4. Expansion of the technology base to assure the long-term defense capability of the FRG.

5. Intensification and concentration of the FRG research potential in information technology with the aim of developing an R and D capability in the public and private sector commensurate in major respects both in quality and quantity with the requirements of future international competition.

The challenges to be met are viewed by the government as a joint task of industry, science and government itself. Confidence in the adaptability and efficiency of sciences and industry as well as cooperation in social matters are major factors in this endeavor.

The government places its trust in the willingness of people to work within a market economy; in the willingness to act as partners by all concerned and in the superior starting position of German industry on the export market.

But the FRG government is also aware of the fact that the challenge posed by information technology cannot be met on a national basis alone. For this reason, it is working within the European Community on the establishment of a homogeneous European market; on a free exchange of goods with third countries and on general guidelines to help strengthen the competitive position of the Community in information technology among other fields. It is therefore also working toward greater cooperation with its European partners. An appropriate starting point for this would be business cooperation on projects of common interest.

II. The Significance of Information Technology for the Economic and Social Future of the FRG.

Information technology—starting with the basic technology of electronics and ranging from the systems concepts of data processing and technological communication to the applications of industrial automation, office technology and entertainment electronics—is of fundamental significance for the economic and social future of the FRG.

Large segments of our society expect further economic growth from it; new jobs; more freedom of movement and more comfort in everyday life; but some are afraid of it.

In view of the weak international economic situation and its continuing impact on the employment picture, the position of the FRG must be assessed without wishful thinking and without irrational fear, if at all possible. The future of information technology must be viewed soberly with an eye to future economic security but without losing sight of the social problems involved.

II/1 The Powerful Role of Information Technology

The welfare of our society depends to a large extent on a healthy economy and on the ability of individuals to perform a job according to their training and their qualifications. Technology has always played a major role in this respect. Over the next decades, information technology--perhaps more than any other technology—will have an impact on the social life of humanity and on the competition among the various economies. This process of change will take place at an accelerated pace because of rapid developments in information technology on a world scale.

The structures, demands and peculiarities of economic life and the work process will change. For instance, information technology may lead to the creation as well as elimination of existing jobs and may call for a re-evaluation of certain professional activities.

The forms of social life—particularly within the family—will be affected as well. Freedom to act on one's own responsibility may become enlarged; but the new technology may also result in a lessening of personal contact. The science advisory board on family issues in the ministry for youth, family and health has done a study on the impact of the new media on family life and made the appropriate recommendations.

The new information technologies will have an impact on political organization and on the democratic decision-making process. And lastly, they will bring about change in our cultural life, since the forms of communication are an important factor shaping the cultural life of a society.

Information technology is of growing importance for the FRG's defense capability. New weapons technologies designed for defensive purposes with electronic guidance capability as well as new technologies for intelligence purposes and communication make it appear possible to attain an enhanced defense capability by means of conventional weapons systems.

Analogous to the ways in which human strength was enhanced as a result of the introduction of machines, information technology, too, operates as a factor which enhances performance. It enhances human intelligence by supporting and expanding on the human faculty to store, process and communicate information:

Even today it makes information rapidly available, establishes connections where none were assumed to exist before and facilitates better understanding.

It helps to overcome spatial and temporal obstacles to communication.

It makes it possible to compute difficult mathematical problems within a reasonable period of time.

It enables us to automate and control production and transportation processes.

It makes routine administrative procedures in the public and private sector manageable the great volume of which could not be handled without such help.

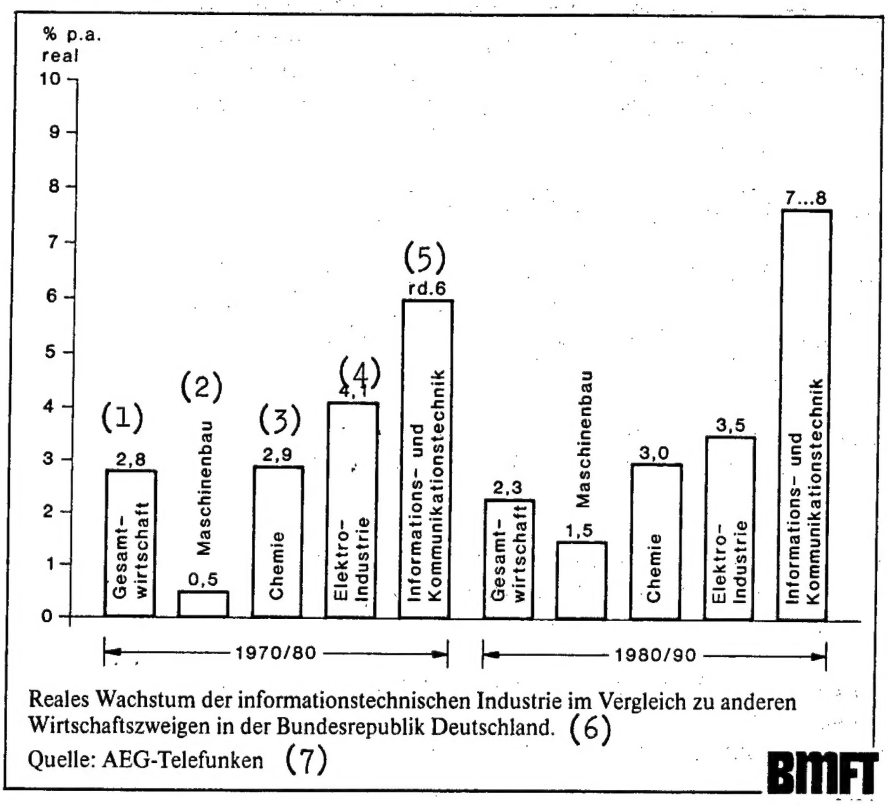
But the new technological capability to collect data also entails certain risks to the preservation of personal privacy and thus places heavy demand on the protection of said privacy.

The development and introduction of information technology is viewed by the government primarily as an opportunity; but the government will also be at pains to counteract any negative impact it may have. This challenge will be met by the FRG in the manner of an open, democratic society. Seizing the opportunities and overcoming the risks calls for a continuing dialogue between the state, the society and the population.

The significance of this key technology has been examined and debated in numerous studies, commission reports, strategy discussions and memoranda prepared by science and industry. A list of the materials used here is contained in a bibliographic annex to this paper. Many suggestions were included in this government concept but not all of them are referred to specifically in the text.

II/2 The Information Technology Industry: A Growth Industry

The information technology industry is a growth industry. If one takes a look at the real growth rates of major sectors of the FRG economy over the past decade, one can clearly see information technology occupying a special position.



Reales Wachstum der informationstechnischen Industrie im Vergleich zu anderen Wirtschaftszweigen in der Bundesrepublik Deutschland. (6)

Quelle: AEG-Telefunken (7)

BMFT

Key:

1. Economy overall
2. Machine tool industry
3. Chemicals
4. Electrical industry
5. Information and Communication Technology
6. Real growth of the information technology industry as compared to other sectors of the economy in the FRG
7. Source: AEG-Telefunken

The figures for this decade as they appear on the foregoing chart show an estimated average annual growth rate of seven to eight percent for the FRG information technology industry, which clearly exceed prospective growth rates of most of the remaining sectors of industry.

U.S. industry representatives estimate that the U.S. information technology industry will advance from the the seventh to the fourth position in the overall ranking of industrial firms by the late eighties and to the number two position by the end of this century. The expectations tied to these growth rates are of major importance to the international competition for markets and jobs.

II/3 Impact of Information Technology on the Economy

From the economic point of view, the production, processing and distribution of information in modern industrial society is increasingly beginning to assume the role of an independent factor of production, next to labor and capital.

This is causing structural change which has a major impact not only in the FRG but also on the economies of all industrial nations throughout the world.

More and more people are no longer directly involved in the production of material goods or services but rather—to a large extent—in the production, processing and distribution of information.

At the same time, however, rapid progress is occurring in information technology which results in greater productivity both in the industrial sector and in administration and the service industry.

This calls for an economic policy which, by providing assistance to structural change, paves the way to more growth and takes competitiveness as such into consideration.

In the view of the experts, there is no reason to assume that information technology products and services will provide a direct and economically overriding incentive to consumer demand. But information technology will certainly be a dominant factor for growth in the capital goods sector. Very few firms can afford any longer to pay no heed to the latest state of information technology in their production processes.

Many experts assume that information technology will come to be of decisive importance for industrial performance overall.

More and more sectors of industry—machine tools, optical products, chemicals or automobiles and particularly electrical engineering—are dependent on information technology for both product design and manufacture. The

information technology imprint on these products is not so much reflected in the actual cost of the technology but in some of the indispensable functions performed by it (such as electronic control, measurement, display, feeling, recognition). These are the electronic operations which decide on the quality and marketability of a product, even if their actual cost is relatively small.

The impact of microelectronics will continue to grow. If one sets the microelectronics utilization rate at 100 for the year 2000, experts estimate that rate today to stand at just 15 percent. These developments are being propelled ahead above all by the extremely rapid increase in complexity and performance of electronic circuits. These are the very developments which point the way to new products and systems solutions in the future which can as yet not be realized from an economic or technological point of view. Data processing and communication technology are transforming into an indissoluble unit which is not only affecting the work process in industrial production but also in the service industry which--as a user of new information technology systems--is being impacted by the changes in the technology itself, as can already be observed in the banking and loan and insurance sectors.

II/4 The Impact of Information Technology on Employment

Information technology provides the entire economy with a means of stepping up productivity and thereby of improving its competitive position. As the most recent studies show, no direct cause-and-effect relationship can be established between an increase in productivity and a reduction in the number of jobs. According to these studies, the number of jobs in the FRG has declined in those sectors of the economy during the past 10 years in which labor productivity rose at a below average rate. Changes on the labor market brought on by these factors are hard to assess in the case of individual technologies.

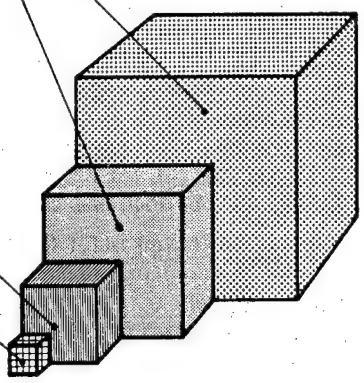
The impact of information technology on production and on the products of modern industrial economies themselves paves the way to structural changes which release strong incentives to growth in those countries which aggressively support such changes. Those who are in a position to take part in growth markets by making innovative use of information technology are in an equally good position--from the point of view of international competition--to create new jobs; to replace obsolete jobs with new ones and to make existing jobs safer for the future. If the FRG does not take advantage of the innovative potential of information technology, old jobs in this country would disappear and new jobs would emerge in other countries instead.

(1) Bruttosozialprodukt
~1.600 Mrd. DM

(2) Umsatzvolumen der fünf wichtigsten Industriezweige mit Bezug zur Informationstechnik
(das sind: Elektrotechnik
Büro- und Datentechnik
Maschinenbau
Straßenfahrzeugbau
Feinmechanik und Optik)
~430 Mrd. DM

(3) Elektronikproduktion
~39 Mrd. DM

(4) Mikroelektronik-Verbrauch
~1,3 Mrd. DM

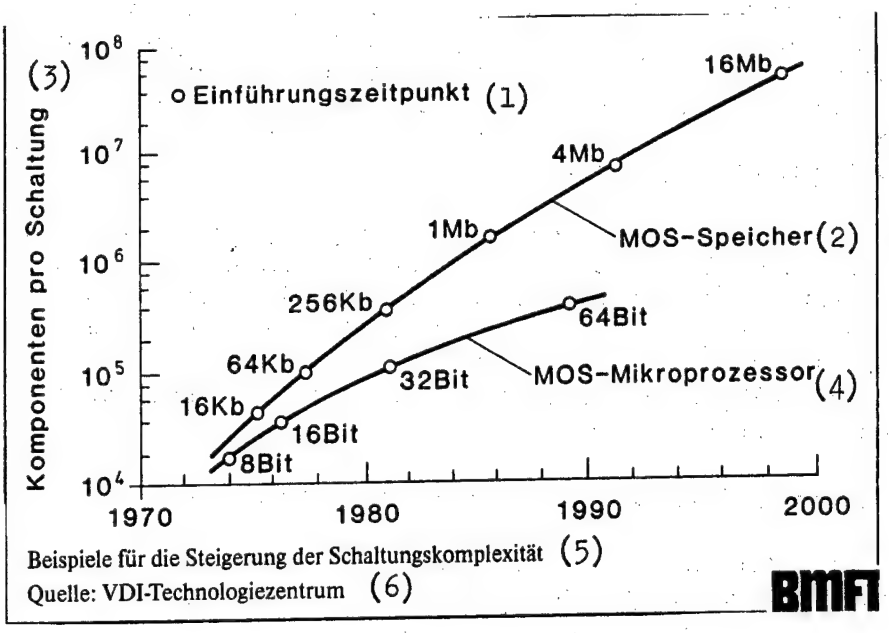


(5) Der Einfluß der Mikroelektronik auf die Volkswirtschaft der Bundesrepublik Deutschland.
(6) (Elektronische Funktionen entscheiden trotz ihres relativ kleinen Anteils am Gesamtwert von Produkten über deren Qualität und Marktchancen.)
Zahlenangaben für 1982
(7) Quelle: Valvo

BMFT

Key:

1. Gross GNP (all figures in billions of DM)
2. Output of the five sectors of industry most important for information technology (i.e. electrical technology; office and data technology; machine tool industry; automobile manufacture; precision mechanics and opticals
3. Electronics output
4. Microelectronics consumption
5. Impact of Microelectronics on the FRG economy
6. (Despite their relatively small share in the total value of a product, electronic operations are decisive in terms of quality and marketability of a product.)
7. Source: Valvo



Key:

1. When first introduced
2. MOS memory
3. Components per circuit
4. MOS microprocessors
5. Examples of increase in circuit complexity
6. Source: German Engineering Society technology center

The training and continuing education sectors will have a particularly important role to play. In many areas, information technology has led to the result that routine operations and objectifiable procedures are no longer performed by human beings but by machines which are programmed by human beings. This in turn calls upon a growing proportion of the labor force to continue to learn, to be able to think in abstract terms and to operate information technology systems.

The need therefore is to take advantage as rapidly as possible and with an eye to the market of the opportunities inherent in the advances and applications of information technology. But job security also is the result of investment in communication systems; new control technologies for the operation of heating plants which save energy and protect the environment; new control technologies for automotive engines and a host of other products for the home and consumer sector.

II/5 The Impact of Information Technology on Public Services

The use of automatic data processing in public administration has by now become a matter of course and there has been marked improvement both in terms of efficiency and economy of operation.

In the past, any expansion of responsibilities linked to then existing technology would frequently lead to less than desirable treatment of the public. Today, the use of modern technology—particularly in those instances where decentralization leads to more comprehensive services—permits public administration to design new patterns which hold the promise of greater economy, a more caring attitude toward the public and an improvement in the quality of services.

The problem of the abuse of personal data has become more serious as a result of the expanded capability to store, collect and evaluate information with the aid of modern information technology. To protect against these dangers, the parliament approved the data protection law (BDSG) which went into effect on 1 January 1978 and which applies both to processing data in the public and private sectors. In the general view, the law has fulfilled its purpose well. If there is a need to adapt the law to technological advances in the field of data processing, the legislation will be amended. In this context, the data protection references contained in the Federal Constitutional Court's 15 December 1983 ruling on the 1983 census law will have to be taken into consideration.

Another problem to be tackled is to see to it that dependence on technological systems does not go so far that any partial malfunction of the technology could lead to serious losses to the individual or to the state and the economy. The experts believe that the vulnerability of a super information society is a problem to which greater attention will have to be paid in the years to come.

The quality of public services—which is both a mark of performance and a competitive factor in a highly developed industrial society like ours—is determined to a very large extent by the existence of an up-to-date information technology infrastructure. For this reason, full advantage must be taken of all advances in information technology.

In the future, the integration of data processing and technical communication—as reflected in text display in the home and data processing networks in public administration, in banking, commerce and insurance—will result in a new kind of service economy enabling the individual citizen to take advantage of public and private services from his own home. This will call for learning processes both for those offering the services and those taking advantage of them.

II/6 The Impact of Information Technology on the Media

With the introduction of television, information technology experienced an extraordinary expansion process. The new technologies will result in major advances in this area. In the print media, too, information technology has resulted in changes with regard to actuality and production techniques and will continue to do so. In view of further technological advances, it will become increasingly difficult to define the previously existing borderline separating individual and mass communication.

In this area, too—as in the case of public services—the advances in information technology will open up new creative opportunities to help transform the passive media consumer into an active participant in the social communication process.

The use of one's own videorecorder; the playback of programs from one's own video library; the use of a television set in conjunction with a text display; video games or group-oriented learning and television programs are good examples of this. Conventional patterns will undergo fundamental change as a result. The government feels it is necessary to take a political approach to these issues in order to take advantage of the opportunities and reduce the risks to a minimum. It plans to develop an appropriate concept for a media code for the future.

II/7 Transformation Processes in Information Technology

It is not only difficult to assess the significance of information technology for the future of the FRG's economy and society because the cause-and-effect relationships are exceedingly complex but also because the technology has an extraordinary dynamics of its own.

Within the field of information technology, data processing technology and communication technology have been developing quite independently of each other and along quite different lines throughout the seventies. The two technologies developed at different rates of speed, carried forward in

different ways by the enormous advances in semiconductor technology. In the future, the two technologies will become more and more integrated in terms of base technologies, systems concepts and markets. As digitalization of information networks and end equipment increases, there will be a technological upheaval we will have to cope with. Visual communication technology is still another medium. The simultaneous emergence of digitalization and visual communication technology represents an extraordinary challenge to industry. The processing and transmission of data, text, audio and video which used to be separated into different phases has now become part of integrated systems solutions. The trend is toward multi-purpose end equipment to be used as part of a service-integrated communications network.

The borderline separating data processing, communication technology, industrial automation, office technology and entertainment electronics is becoming fluid. One example of this would be the design of an "intelligent" home terminal which serves as a multi-purpose unit combining entertainment, data processing and communication technology.

The motor propelling this change is microelectronics which has resulted in the manufacture of smaller, less expensive and more efficient computers. The great increase in computers equipped with microprocessors (for use at the workplace) contrasted with the decline percentagewise in the market share of CPU's of general purpose computers is clear evidence of this trend.

The increasing complexity of the systems is accompanied by increased consumer demand regarding the "user surface" of the computers. High-grade video screens, audio recognition and audio response; video input, manipulation and response and, above all, easier operation of complex systems with the help of easy-to-use software are all characteristic for this trend. The gradual transition from data processing to information processing is considered to be the most significant long-range prospect.

For another thing, the rapidity of the innovations results in a shorter production cycle on the market. Information technology producers are under constant pressure to improve their products, taking advantage of technological advances.

This, in turn, leads to more intense competition and forces industry to devote enormous energies to research and development which are of such a magnitude that they can in many instances no longer be effected by individual firms alone. Competition on the marketplace and cooperation between competitors in product development is therefore a frequent, simultaneous phenomenon taking place in this industry.

Imaginative and technologically sound speculation on the transformation processes in information technology; substantial investment in research and development and a sophisticated marketing operation all are basic strategies to be pursued by firms wishing to take full advantage of the changes in information technology.

A joint effort undertaken by the Technical Universities of Erlangen, Hanover and Karlsruhe as well as Siegen University and Furtwangen Technical College produced the first German multiproject chips on a gate array basis: 60 designs on a total of 15 chips. The layout was designed by students of the abovementioned institutions as part of a work project. The layout data were transferred to the interactive graphic system of AEG-Telefunken at Ulm.

III. The State of Information Technology from the International Point of View

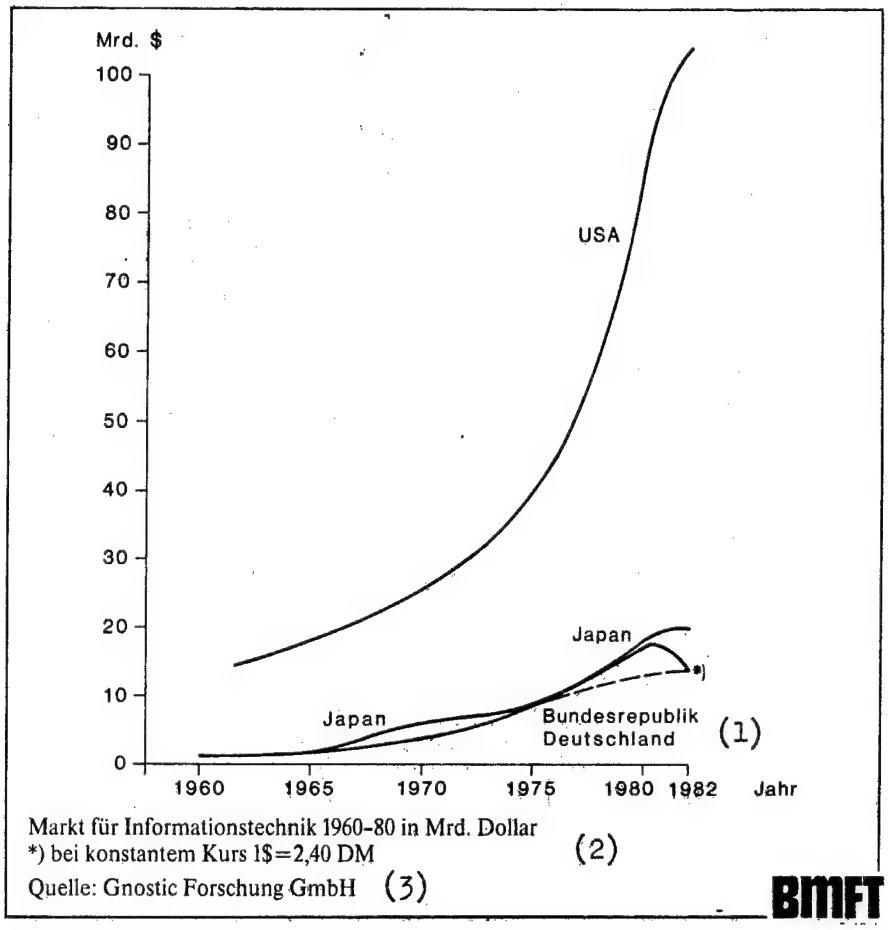
Information technology includes five areas which are not distinctly separate:

—Electronic components and microelectronic systems
—Technical communication
—Entertainment electronics
—Data processing and office technology
—Industrial automation

The graphs below show the world market trends since 1960 for U.S., Japanese and German information technology products. Japan has clearly outpaced the FRG in terms of production volume, which is a clear indication of the growing strength of the Japanese industry on the export market. This relative German weakness is in contrast to the export strength of German industry in other sectors of the economy in which the focus has been on integration of information technology and mechanical engineering to achieve new systems operations. Aside from the anticipated rapid growth of the market volume in all three countries, it is worth noting that the Japanese market—starting out at a relatively inferior position—developed along somewhat similar lines as the German market.

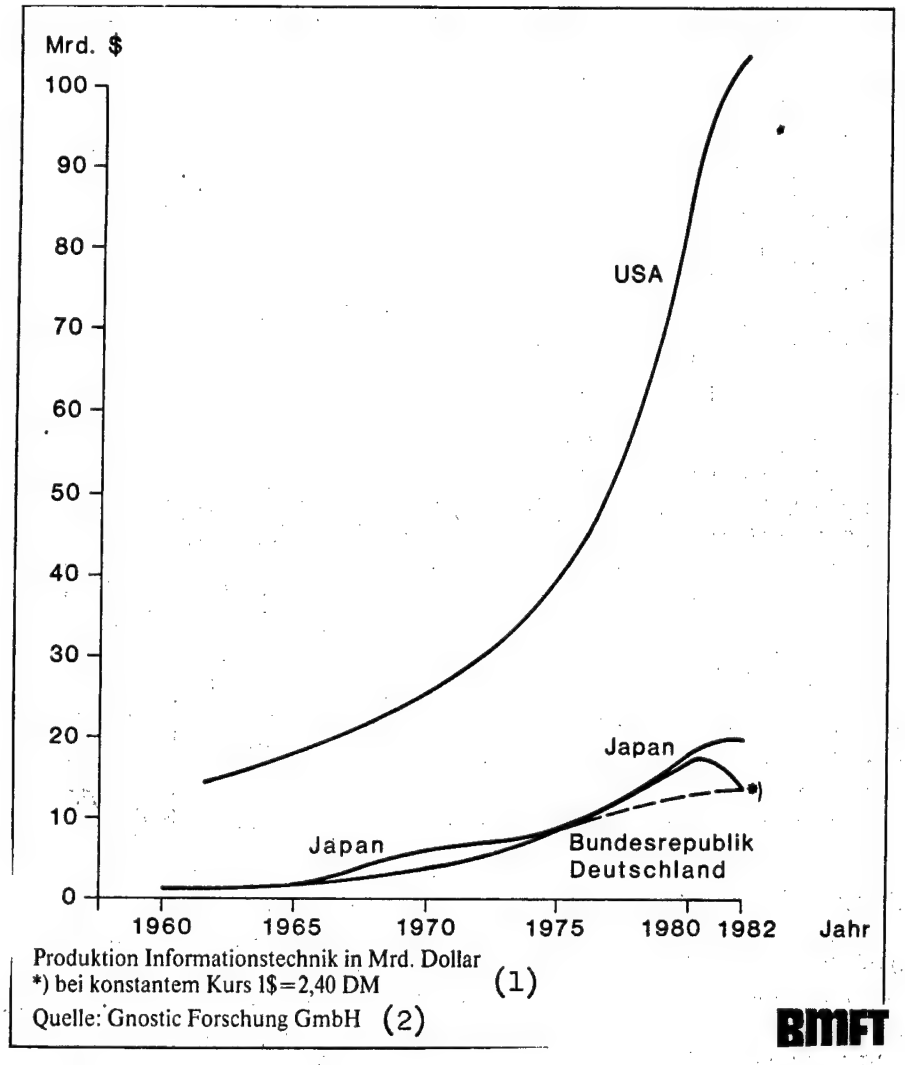
Worldwide, the FRG is one of the leading exporters and despite a slight decline in its share of world exports during the seventies it is still clearly ahead of Japan whose population is larger. The FRG still earns more than one-quarter of its GNP from exports. It is therefore not only a strong exporter but also a country which depends on exports—which is why the export picture has a distinct bearing on technological achievements.

As another of the graphs below shows, machinery, automobiles, chemicals and electrical engineering products make up more than half of the exports. According to 1980 OECD statistics, products with a primary electronic function amounted to only 12 percent of the total. According to these same sources, the corresponding figure for Japan was 22 percent.



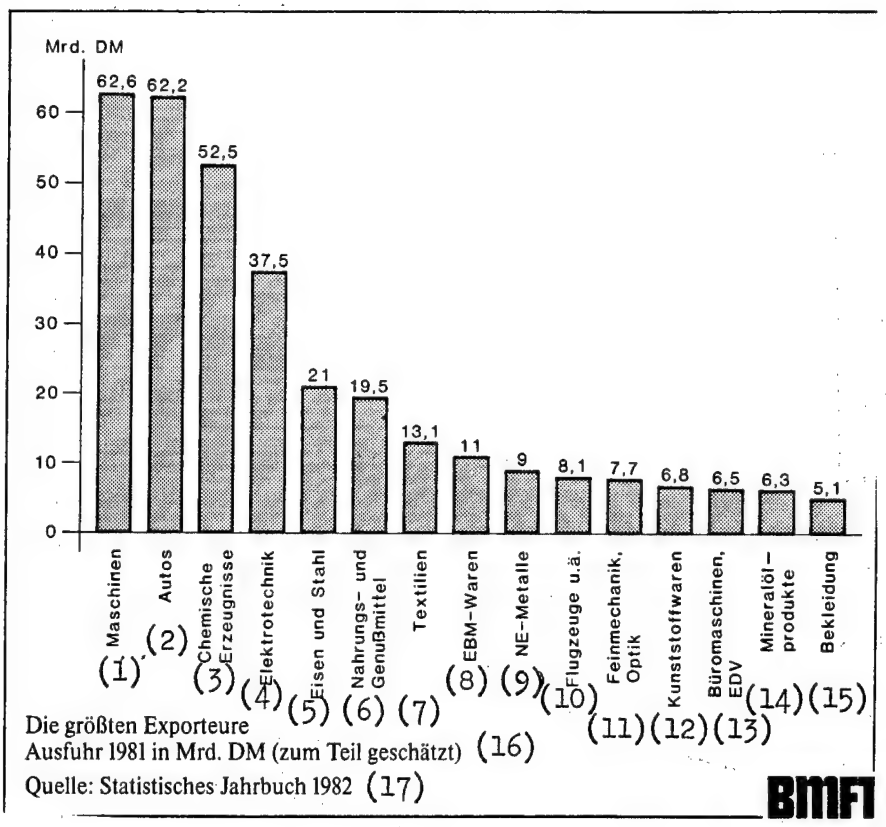
Key:

1. FRG
2. Information technology market 1960-1980 in billions of dollars at constant DM 2.40 per dollar exchange rate
3. Source: Gnostic Research Ltd



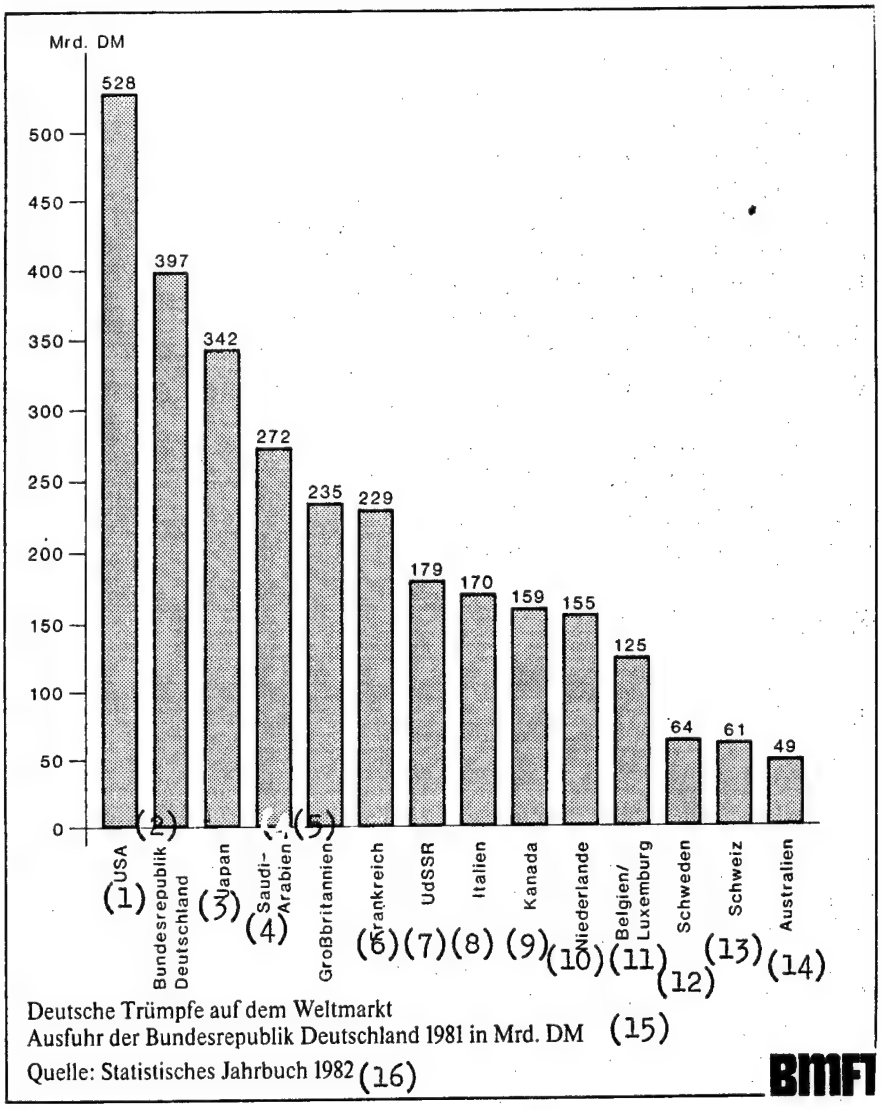
Key:

1. Information technology output in billions of dollars at constant DM 2.40 per dollar exchange rate
2. Source: Gnostic Research Ltd



Key:

1. Machinery
2. Automobiles
3. Chemicals
4. Electrical engineering
5. Iron and steel
6. Food products, luxury foods
7. Textiles
8. Metal goods
9. Non-ferrous metals
10. Aircraft, etc.
11. Precision machinery, opticals
12. Plastic goods
13. Office equipment, EDP
14. Petroleum products
15. Clothing
16. Major FRG export industries: 1981 exports in billions of DM (partly estimated)
17. Source: 1982 Statistical Yearbook



Key:

1. United States
2. FRG
3. Japan
4. Saudi Arabia
5. Great Britain
6. France
7. Soviet Union
8. Italy
9. Canada
10. Netherlands
11. Belgium/Luxembourg
12. Sweden
13. Switzerland
14. Australia
15. FRG exports in 1981 in billions of of DM
16. Source: 1982 Statistical Yearbook

But it must also be noted that communication and information technology is increasingly being characterized by an international technological and economic race of strategic proportions--with the European nations fighting for longer-term domination or against falling behind. In many instances, government and industry are collaborating closely in this endeavor. Government assistance in other countries is not merely restricted to research and development but includes to a much larger extent than in our case government contracts (as in the United States); government contracts with deficit guarantees (as in France and England) or even joint strategic planning by government and industry coupled with strong support in innovation, growth and/ or exports (as in Japan).

The five areas of information and communication technology are discussed individually and in detail below. Because of the limited value of the available data, the statistics themselves should merely be read as indicators for general patterns and trends.

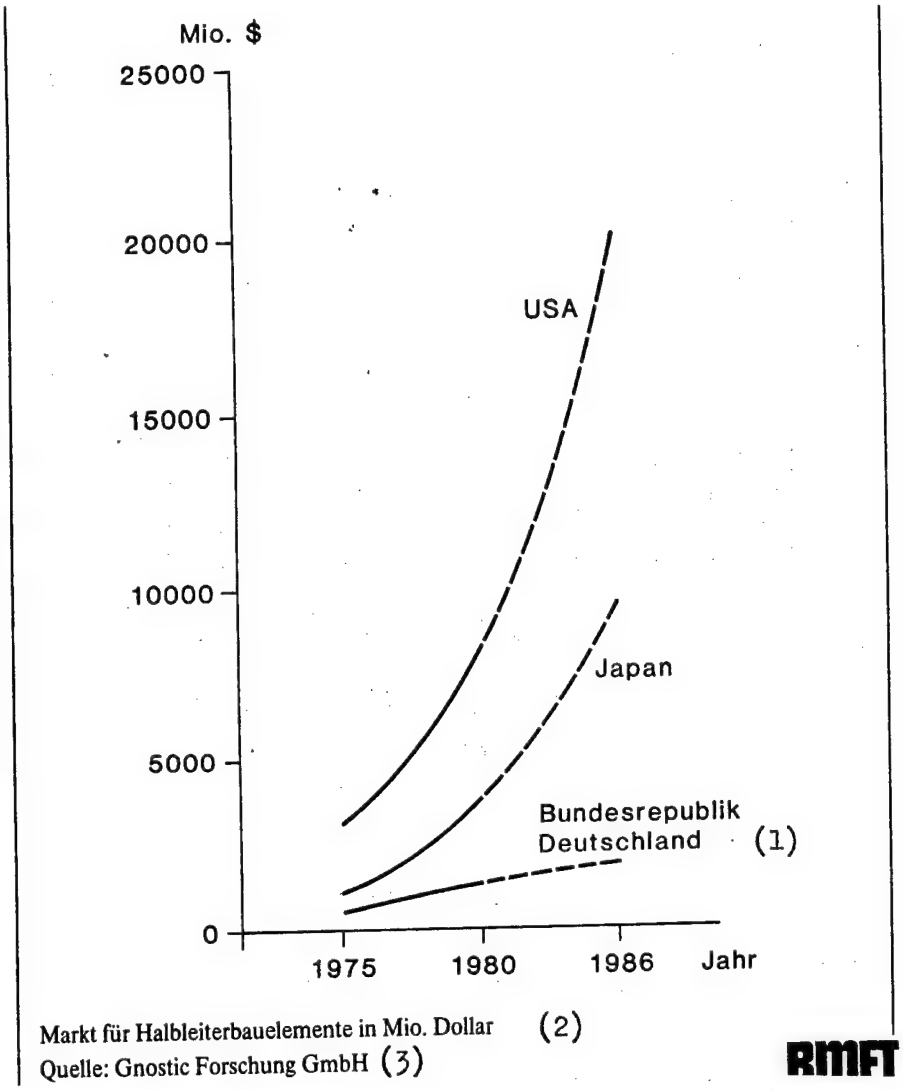
III/1 Electronic Components

Market trends in electronic components are determined by the production of integrated circuits. The experts expect the market share of integrated circuits to climb from less than one-fourth to one-third in the FRG between 1980 and 1986 and from one-third to 50 percent in the United States during the same period. These trends are depicted in one the following graphs.

Another graph shows the market growth rates for semiconductors in Japan, the United States and the FRG starting in 1975. The graph clearly demonstrates the relatively weak growth rate of the microelectronics market in the FRG. In fact, the demand for integrated circuits in terms of GNP is not even half as great at this time as in the United States and Japan. This is due to the fact that the United States occupies a dominant position in the data processing market and Japan has a like position in entertainment electronics. Furthermore, it is an indication of the fact that the information technology markets tend to support each other and that weaknesses in any sector of the market have an impact on the information technology market as a whole.

It therefore follows that the production of integrated circuits in the FRG is not what it should be.

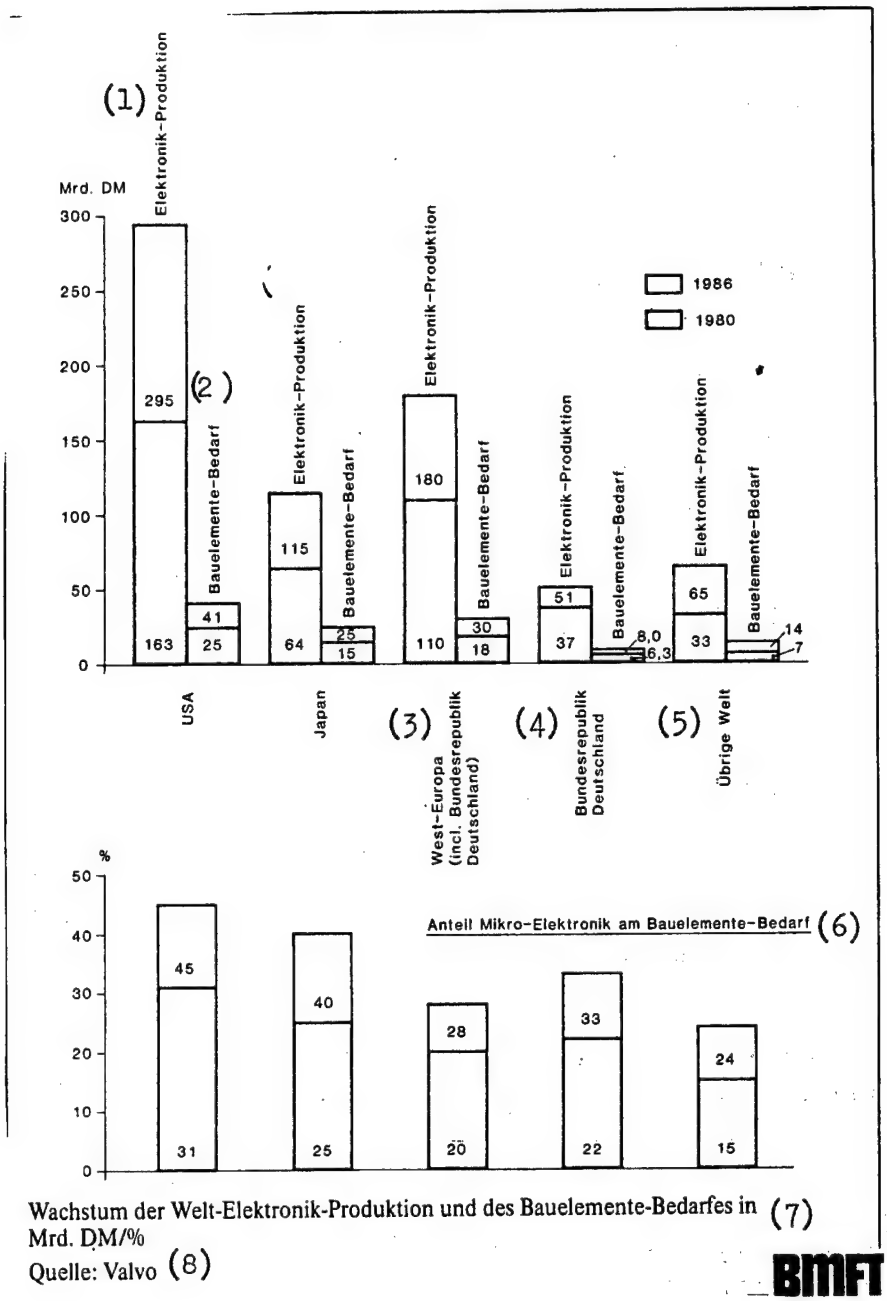
The Gnostic market research organization has found that both the United States' and Japanese output exceeds domestic demand (with most of the excess going to Europe) while 60 percent of the domestic market in the FRG was being supplied with native products in 1982. According to figures made public by the Japanese finance ministry, 1982 exports of integrated circuits to the FRG rose by 57 percent as against the year before while Japanese imports of IC's from Germany declined by 25 percent. Many observers believe that the danger of dependence on foreign know-how in advanced IC's has been growing over the past several years.



Markt für Halbleiterbauelemente in Mio. Dollar (2)
Quelle: Gnostic Forschung GmbH (3)

RMFT

Key:
1. FRG
2. Semiconductor component market in millions of dollars
3. Source: Gnostic Research Ltd



Wachstum der Welt-Elektronik-Produktion und des Bauelemente-Bedarfes in Mrd. DM/% (7)

Quelle: Valvo (8)

BMFT

Key:

1. Electronics output
2. Component demand
3. Western Europe (including FRG)
4. FRG
5. Rest of world
6. Microelectronics share of component demand
7. Growth of world electronics output and component demand in billions of DM
8. Source: Valvo

The next graph also makes it clear that German IC manufacturers are not playing anything like a significant role internationally at this time. Investment in microelectronics research and development in the FRG is correspondingly low, although the expenditures of the German manufacturers are higher than average in relative terms. In spite of the relatively small R and D budget, there is no reason not to speak in positive terms of the FRG microelectronics industry's current standing and development potential which has been achieved in part with the assistance of the ministry for research and technology. But in the absence of more than average growth of the market and a rise in production, the German microelectronics industry will not be able to hold on to its strong technological position.

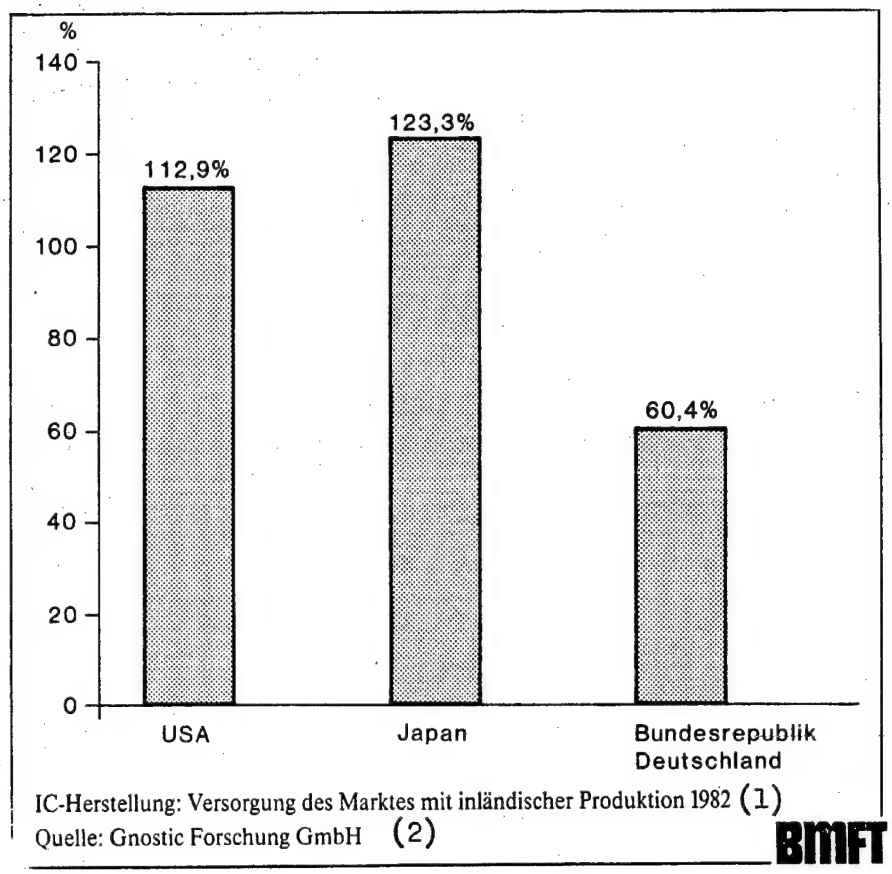
The increased complexity of integrated circuits is beginning to transform them into separate systems of their own. In that way, they are playing a part in the division of labor practices of component and equipment manufacturers. Because of the key role which the IC's play in numerous branches of industry, a good working relationship between users and producers of microelectronics equipment is of the essence for the economic development of Europe generally and the FRG in particular.

III/2 Technological Communication

Telecommunications, including wire and wireless communications technology as well as telephone cable, continues to be one of the growth industries in electrical engineering with an output valued at DM 10.8 billion and a labor force of 110,000 employees. While output increased by 46 percent over the 5-year span from 1975 to 1980, imports doubled to DM 1.3 billion. Exports have been stagnating for years at just under 30 percent and are markedly below the 50 percent overall export figure achieved by the electrical industry. The telecommunications market is a market influenced by the government and largely dominated by the domestic monopoly on demand by the German Postal Service.

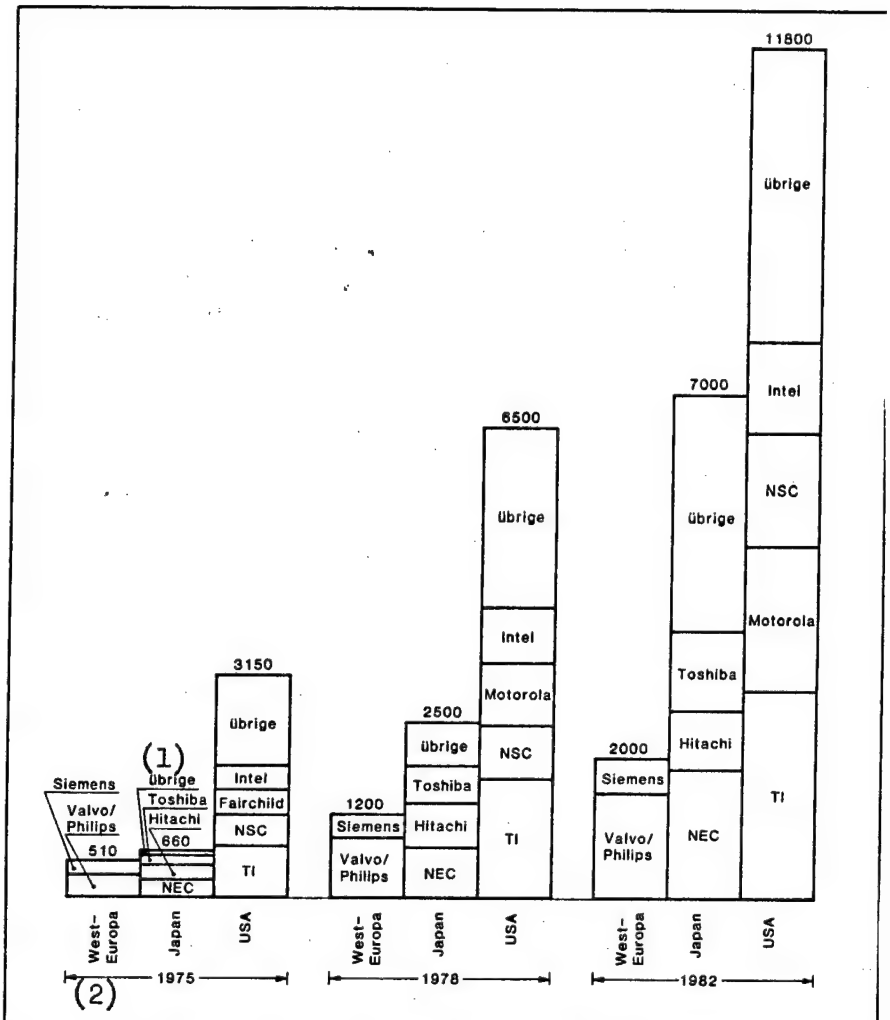
In contrast to the microelectronics, EDP and entertainment electronics market, the domestic communication technology market is still in the hands of economically viable German manufacturers.

The lion's share still goes to the telephone industry. By the mid-eighties, the full expansion of the telephone network and coverage of virtually the entire country will have been achieved. It is therefore imperative that the future markets inherent in the new communication technologies be developed as rapidly as possible. This includes digitalization of propagation and relay technology, the introduction of fiber technology and the use of point-to-point communication satellites for the transmission of telephone and data traffic.



Key:

1. IC production: supplying the market from domestic production in 1982
2. Source: Gnostic Research Ltd



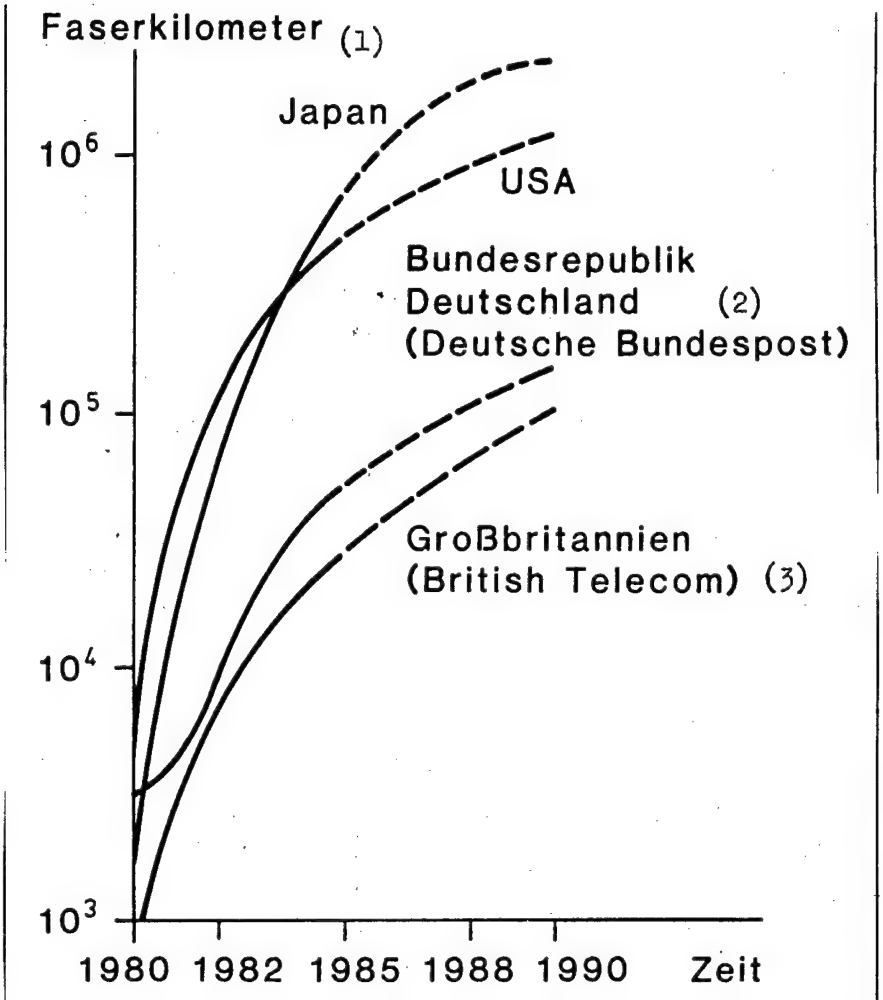
Aufteilung des Umsatzvolumens der weltweit zwanzig größten IC-Hersteller (3)
(in Mio. DM)

Quelle: Valvo (4)

BMFT

Key:

1. Others
2. Western Europe
3. Distribution of sales volume among 20 of the largest IC manufacturers in the world in millions of DM
4. Source: Valvo



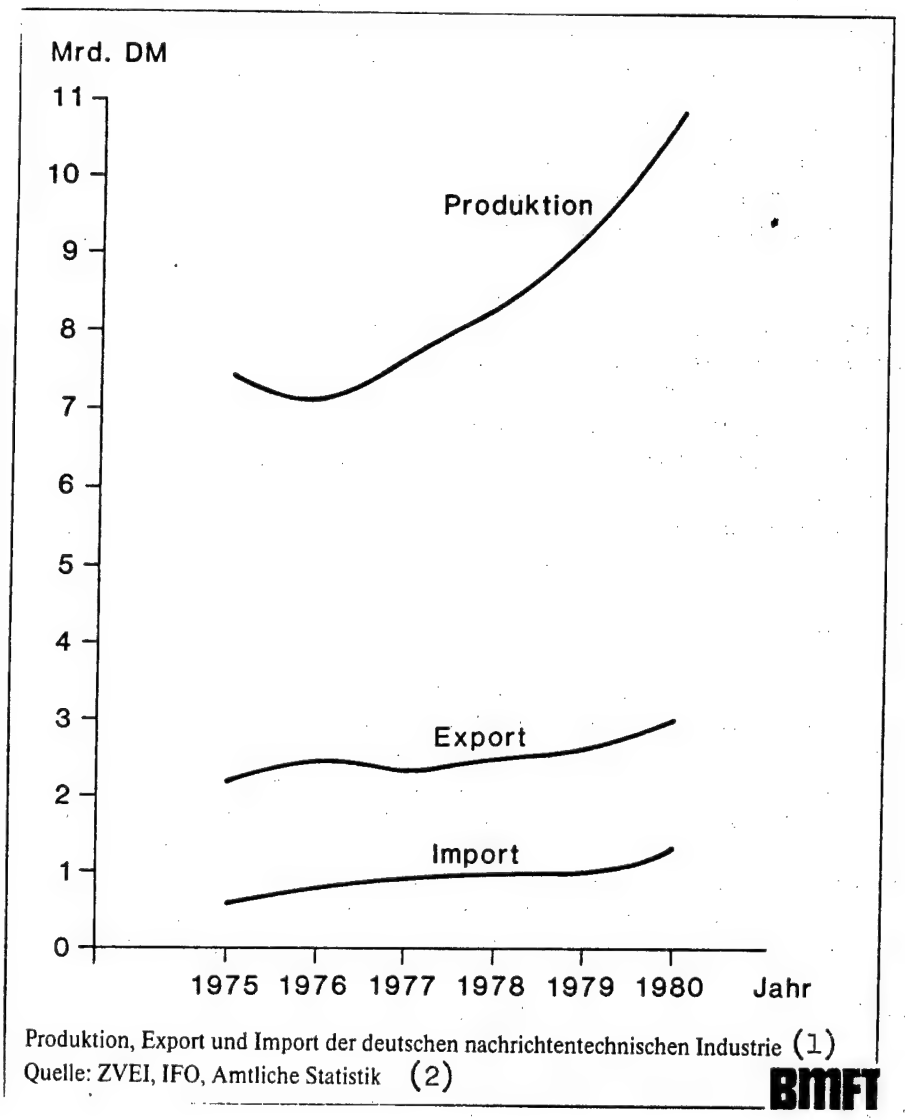
Derzeitiger und erwarteter Bedarf an Faserkilometern für Lichtwellenleitersysteme (Summenkurve) (4)

Quelle: telcom report 6 (1983) (5)
Beiheft „Nachrichtenübertragung mit Licht"

BMFT

Key:

1. Fiber kilometers
2. FRG (German Postal Service)
3. Great Britain
4. Current and anticipated demand in fiber kilometers for light wave conductor systems (summing curve)
5. Source: telcom report 6 (1983); supplement "Telecommunications with the Aid of Light"



Produktion, Export und Import der deutschen nachrichtentechnischen Industrie (1)
Quelle: ZVEI, IFO, Amtliche Statistik (2)

BMFT

Key:

1. Output, export and import figures of German telecommunications industry
2. Various statistical institutes

Especially high growth rates are expected in new services where a combination of different technologies (such as telephone and television) result in inexpensive equipment and mass markets (such as videotext).

Similar growth rates are also expected in the eighties for mobile automatic telephone systems and a wide variety of technological communication end equipment, if the appropriate introduction strategies for the network infrastructures are accomplished.

The most important factor for expansion of the communications system in the FRG in the eighties will be the digitalization of the telephone system down to the individual subscriber. Over the past few years, the German telecommunications industry has caught up in digital relay technology with the French and Swedish firms which are the leaders in this field. The FRG is still behind the United States and Japan in fiber technology and will remain so unless the market hopes can be revised upward. One of the graphs below shows present and future demand in fiber kilometers—with the FRG far behind both the United States and Japan.

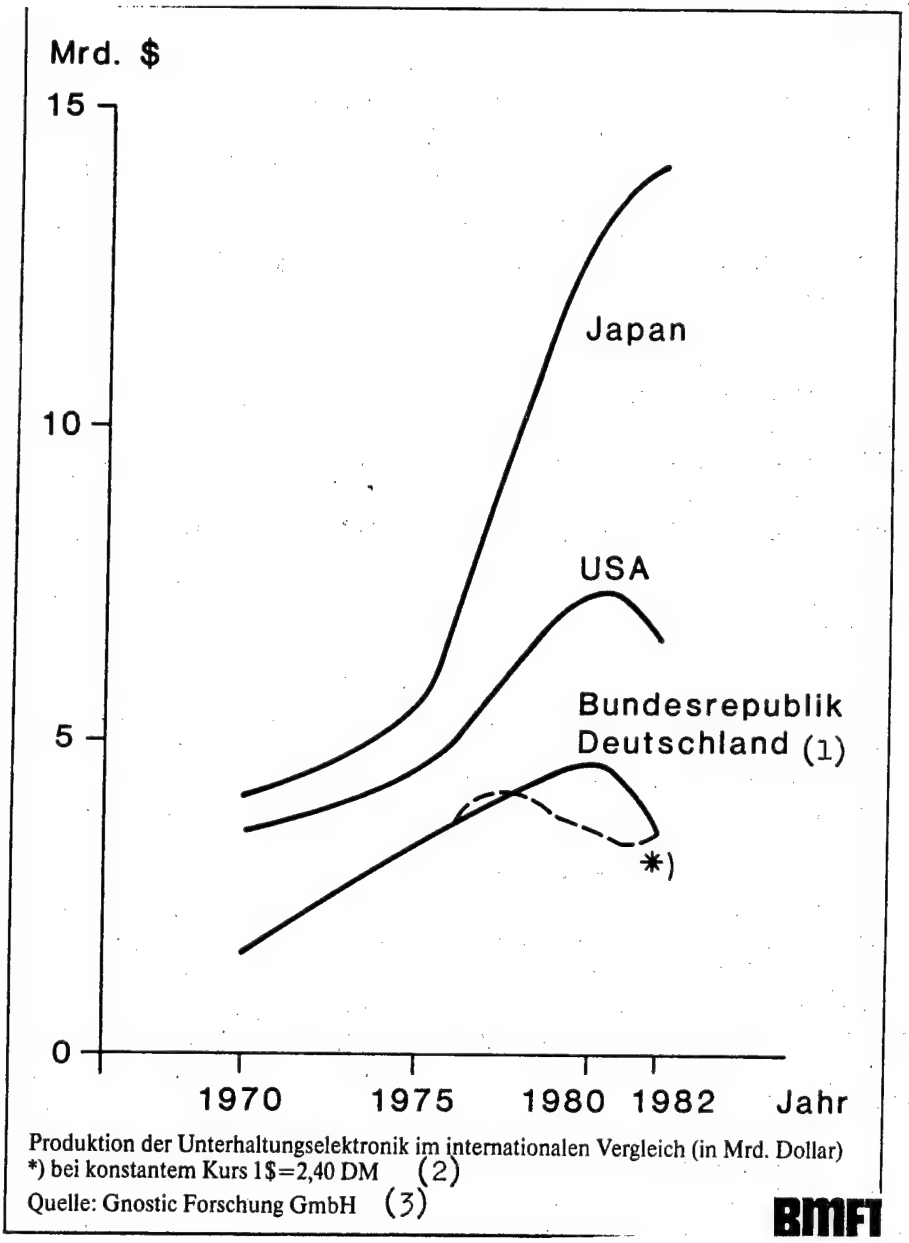
III/3 Entertainment Electronics

The entertainment electronics market, too, is increasingly dependent on the development of the telecommunications infrastructure. Satellite technology, cable networks, high-resolution television but also videotexts and the overall trend toward digitalization will have a strong impact on the FRG's entertainment electronics industry and open up new opportunities for it.

The highest growth rates are presently being achieved in the video market. According to the German Video Institute, only 13 percent of all households are presently equipped with videorecorders. Since this figure will have climbed to 25 percent by 1985, the video market—according to these projections—will be one of the major growth factors in the entertainment electronics market.

At this time, however, the German entertainment electronics industry is faced with a difficult situation. The market in TV sets is stagnating or at best growing slowly; the pressure from imports is growing; prices are falling and profits are down. On the hi-fi market, competition has been intense for years; now the same thing holds true for the video market. Falling prices are a reflection of this competitive struggle. Over the past 3 years, producer prices have declined by some 12 percent.

The output figures for the FRG since 1970 as compared to Japan show that German industry has been falling behind steadily. For a long time, the German entertainment electronics industry was known as being very strong in exports. But as of 1976, export surpluses started declining and in 1981, the first import surplus of about DM 500 million was registered. Japanese products have since taken over about 25 percent of the market.



Produktion der Unterhaltungselektronik im internationalen Vergleich (in Mrd. Dollar)
*) bei konstantem Kurs 1$=2,40 DM (2)
Quelle: Gnostic Forschung GmbH (3)

BMFT

Key:

1. FRG
2. International entertainment electronics output in billions of dollars at constant DM 2.40 per dollar exchange rate
3. Source: Gnostics Research Ltd

III/4 Data Processing and Office Technology

The world market for data processing systems amounted to $52 billion in 1981. Half of this amount went to the United States and one-third to Europe and about one-quarter of this latter amount went to the FRG. The German share of the world market thus amounts to between six and eight percent.

Since the mid-seventies, production and domestic supply have been rising appreciably. Over the past few years, data processing has been one of the most reliable growth areas in the information technology industry.

The above average growth rates of 15 and 22 percent between 1975 and 1981 of the two largest German firms are worth noting. Europe-wide, the technological starting position of the FRG is not unfavorable by any means. In fact, the German data processing industry is the only one of its kind in Europe which can draw a semiconductor base of its own and presently possesses the fastest computer in Europe from its own development program.

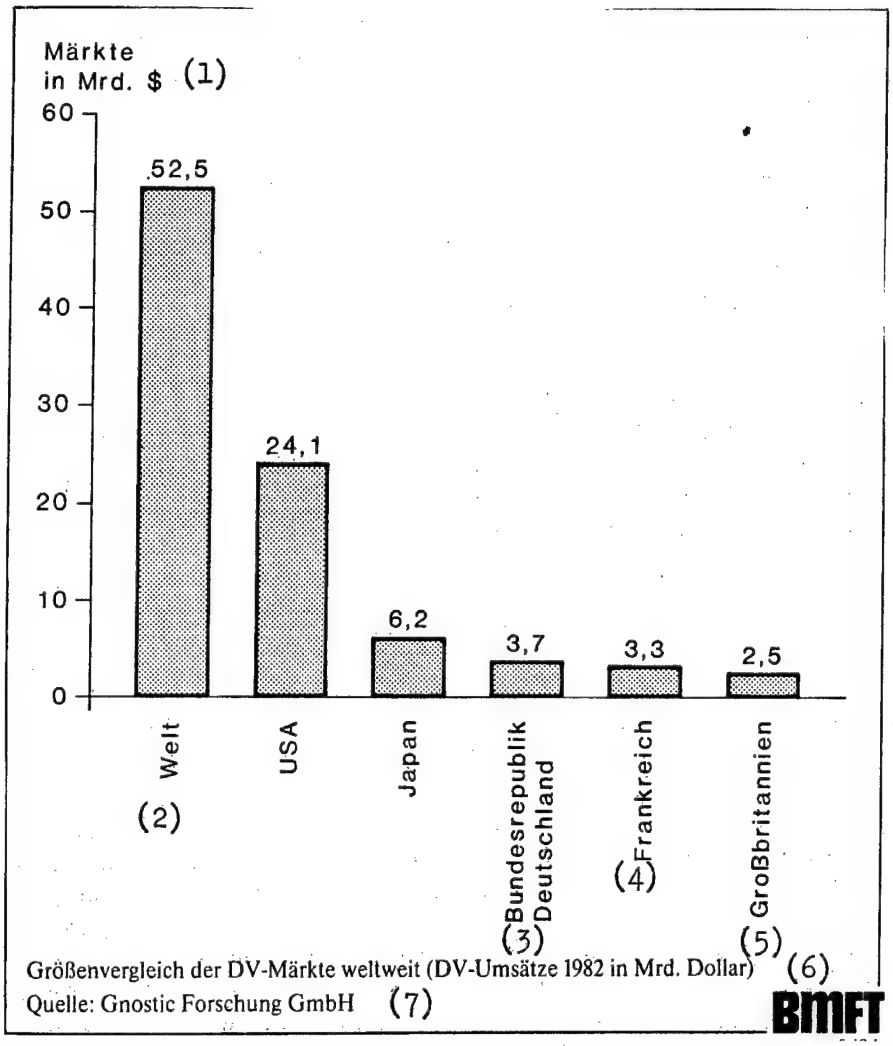
Nonetheless, a study of the effectiveness of past data processing assistance programs comes to the following conclusion:

"Although the German data processing industry has been able to build on its technological position with the help of past assistance and was able to achieve significant market growth, the position of the German producers is not yet permanently secure both in terms of international competition and in view of further change in product and systems segments."

An important sector of the German data processing industry is the manufacture of software. Software did not begin to be considered a separate branch of production until 1970—when the "unbundling" of hardware and software sales took place. Since the seventies, the software sector has been the fastest growing part of the data processing industry. Currently, the software share of the total data processing market amounts to 22 percent and is expected to reach 35 percent worldwide by 1986. This represents an annual growth rate of some 30 percent.

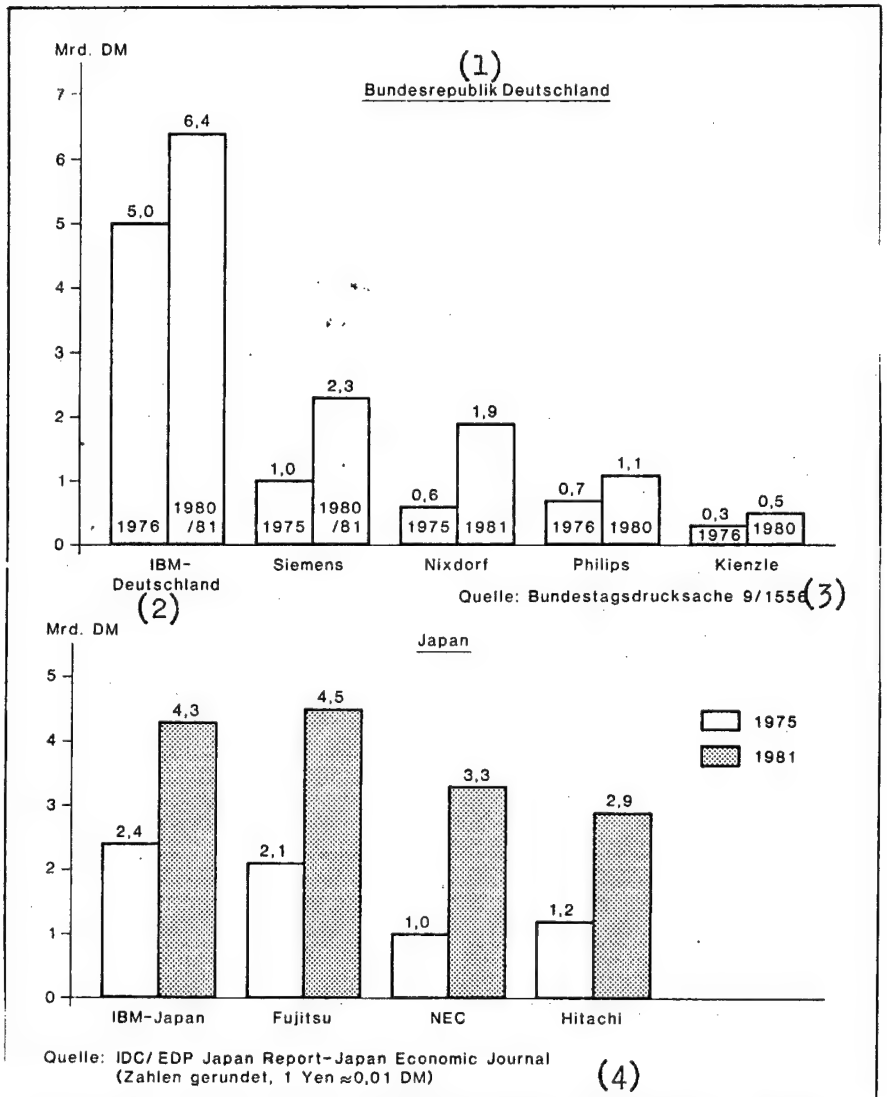
In 1982, software sales in the FRG amounted to DM 6.8 billion. The annual growth rate until 1987 is estimated at 28 percent. The systems and software manufacturers' share of the market amounts to 43.5 percent; that of the hardware firms to just under 30 percent and that of the data processing users to 20 percent.

Of the more than 1,000 systems and software producers in the FRG by far the greatest number are small or very small firms. Only about two dozen firms currently earn more than DM 10 million a year; but even these firms primarily supply the domestic market and are scarcely active in the software export field while an array of American as well as French and British software manufacturers with a solid capital base are very active in the export field.



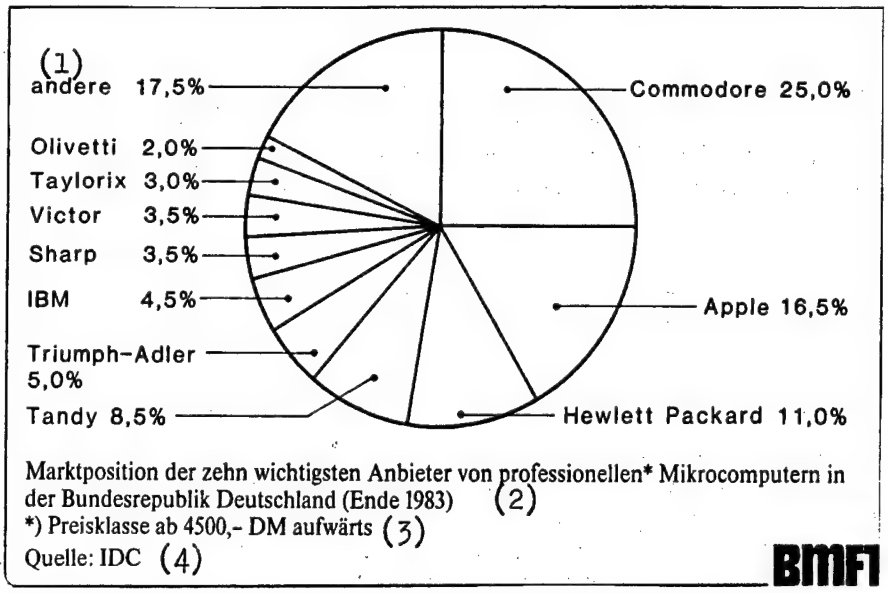
Key:

1. Markets in billions of dollars
2. World
3. FRG
4. France
5. Great Britain
6. Comparison of data processing markets worldwide (1982 sales in billions of dollars)
7. Source: Gnostic Research Ltd



Key:

1. FRG
2. IBM Germany
3. Source: German Bundestag official document 9/1556
4. Source: IDC/EDP Japan Report—Japan Economic Journal (figures rounded off to 1 yen equals approximately DM 0.01
5. Comparison of 1975-1981sales trends of largest data processing equipment manufacturers in FRG and Japan



Key:

1. Others
2. Market position of 10 major suppliers of professional microcomputers in FRG (late 1983)
3. DM 4,500 price category and up
4. Source: IDC

The entire office and information technology sector is presently undergoing structural change--which is marked by decentralization and information processing.

Decentralization is the result above all of the rapidly growing personal computer market. Although German industry occupies a strong position in both ancillary fields--in office typewriters and mid-level data technology--it has been paying little attention to the personal computer field thus far.

In terms of units, the personal computer market is the fastest growing sector of the European data processing market; but it is clearly dominated by U.S. manufacturers.

As far as the future-oriented developments in information technology are concerned which may in the final analysis result in a fundamental improvement in the interface between users and data processing systems, German industry is still in an early phase. The Japanese government, for its part, with its "fifth generation of computers" program is pursuing lofty goals which may conceivably set new standards but which will in any event result in new computer designs. German industry has taken up this challenge; but since it is confronted by a largely government-supported program (as in the case of Japan), its position is a difficult one.

III/5 Industrial Automation

The main goals of industrial automation are greater flexibility and productivity. These demands are the result of a market-conditioned requirement to honor customer requests more rapidly and individually particularly with regard to small series without departing too much from the cost of larger series.

The most important equipment requirements are the following:

Process data processing equipment; production controls and computer aided design and construction systems (CAD's and CAM's); numeric control (NC) equipment; flexible production systems; industrial robots and handling systems.

In the process data processing field, the German manufacturing base is more than acceptable; its share of the domestic market being greater than that of its foreign competitors.

CAD/CAM is designed to increase efficiency in the planning, construction and production process. The corresponding equipment and systems have been on the market in appreciable numbers for only a few years and are presently being used by but a few firms (such as large automobile manufacturers). In medium-sized industries (such as machine tools, for instance), CAD/CAM use stands at just 2 or 3 percent. In Japan, it is said that as much as one-quarter of the machine tool industry already uses CAD systems. The reason

why this is of the greatest importance is that more and more sectors of industry depend on CAD/CAM's in their development programs. This may result in additional dependence on foreign countries. The CAD hardware and basic software market today is firmly to preponderantly in the hands of U.S. suppliers who have access to modern technology and a sophisticated domestic market.

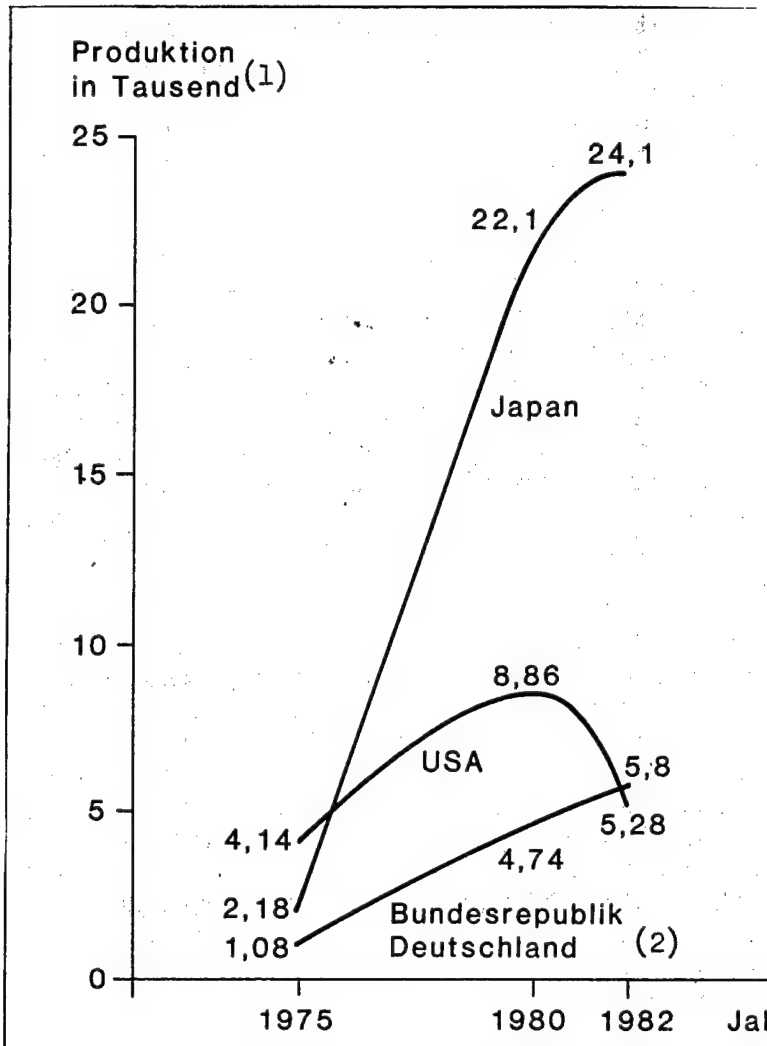
German production of numerically controlled machine tools has grown sixfold since 1975, helping the FRG keep pace with overall worldwide production trends. The production of NC sets of machines of overall machine tool production climbed from 5.6 percent in 1971 to 22.5 percent in 1981. Up to 50 percent of domestic production goes into export; but imports of NC machine tools also amount to about 50 percent. Although German firms occupy a good position in special machinery and high-performance machines, the Japanese are dominant in normal and standard machinery where efficient production in large series pays off in terms of large advantages in cost. This also explains why Japan produces $2\frac{1}{2}$ times as many NC machines per capita as the FRG.

The goal of the use of flexible production systems is above all to increase output of small and medium-sized lots. While the prognosis in the seventies was that flexible production systems would have a great and rapidly growing future, actual developments have stayed far behind expectations. This is due most of all to the fact that the problems involved in the development and operation of such systems are a good deal greater than originally expected. In 1981, some 15 such facilities were in operation in the FRG; some 20 in the United States and more than 35 in Japan. While the systems installed in the FRG contain highly sophisticated equipment—which are capable of top performance by any international standard—the American and Japanese systems presently in operation are less sophisticated and contain fewer subsystems.

The majority of the production technology machinery manufactured in the FRG is fully up to international standards.

In the industrial robotics and manipulation systems field—which is one of the major areas of manipulation technology—the FRG's industrial base is still quite narrow. Of all the robots in operation in the FRG by the end of 1982 about 40 percent were imported. At this time, there are only about 20 firms in the FRG which manufacture robots in appreciable numbers (overall production being valued at some DM 220 million. VW, the largest German producer of robots (worth about DM 100 million) has been turning them out exclusively for its own use.

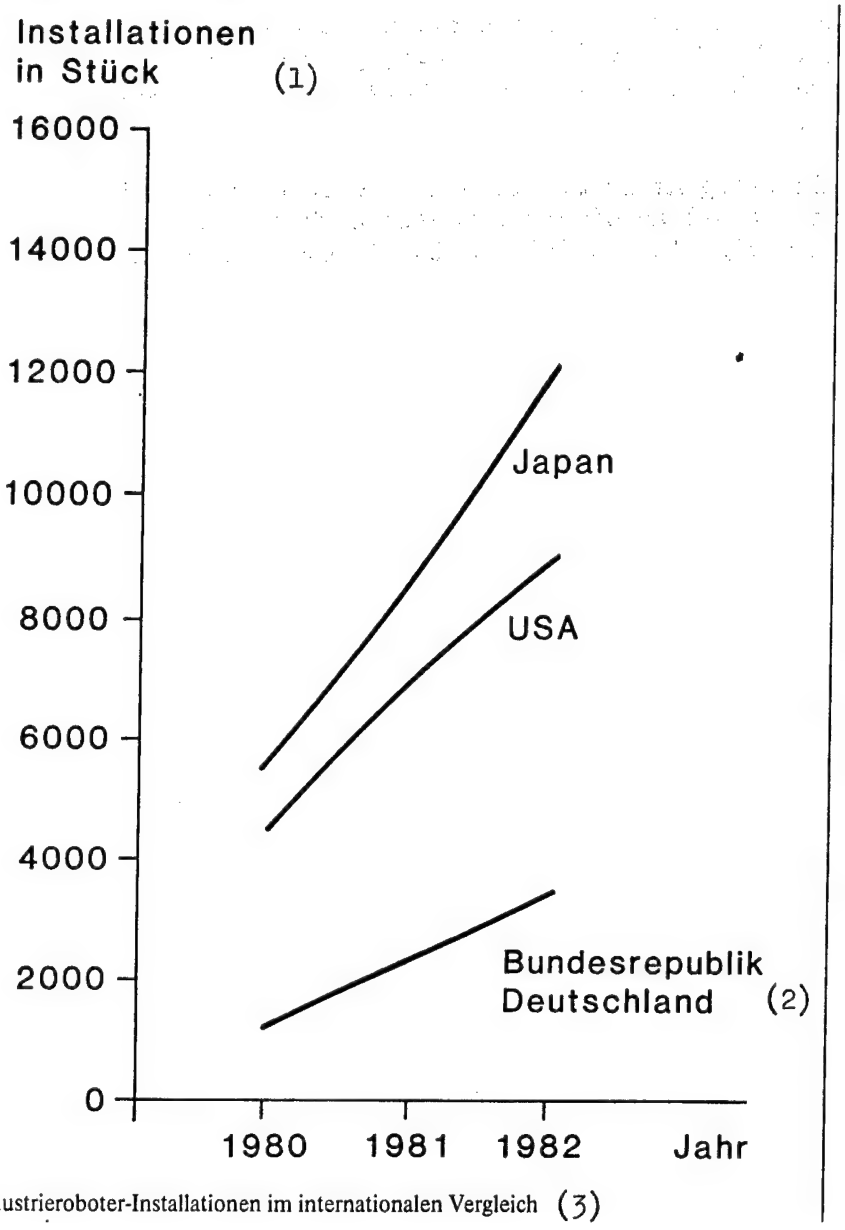
Robot installations in Japan are at least three times as numerous as in the FRG. In Japan, there are some 250 manufacturers whose production was valued at some DM 1.2 billion in 1981—DM 840 million of which were industrial robots in the strict sense and these were manufactured by about 50 firms. The largest and most productive robot factories worldwide are located in the United States.



Produktion von NC-Maschinen im internationalen Vergleich 1975-82
(Anmerkung: Entwicklung weniger dramatisch, wenn Werte in Dollar statt realer Produktion in Stück zugrundegelegt wird.) (3)

Key:

1. Output in thousands
2. FRG
3. International output of NC machinery 1975-1982
   (Note: trends are less dramatic when dollar values instead of real unit production figures are used)



Industrieroboter-Installationen im internationalen Vergleich (3)

Key:

1. Numbers in actual use
2. FRG
3. International industrial robot installations

While use of robots is to a large extent concentrated in the automobile industry today, the focus will increasingly be on automobile assembly in the future because this is where the primary output reserves would appear to exist.

The use of intelligent robots in this sector opens up the possibility of new solutions of extraordinary dimensions which German industry dare not pass up with a view to its international competitive standing.

IV. Goals of the FRG Government

The FRG government declaration of 4 May 1983 stated that the government was resolved to meet the technological challenge. "Our society is in need of technical progress," the declaration said. The government emphasized that it was looking forward to new opportunities for growth as well as future-oriented areas of activity within the context of the stormy development of information and communication technology.

The primary goal of the economic, fiscal and labor market policy of the government continues to be the fight against unemployment. For this reason, new jobs must be created which can only be done by intensified investment and sustained economic growth. This in turn reflects a need for greater opportunity and for the encouragement of private initiative as well as a reduction in the economic activities of government and its interference in business. But above all, there is a need for further improvement of the climate of private innovative and investment activity and for strengthening the investment potential of industry--because innovative and, in the end, productive investment is the key to the growth and competitiveness of our economy.

This presumes that the economy will take advantage of the opportunities arising from the application of new technological knowledge and new technologies. But taking advantage of these opportunities also means meeting and overcoming the challenges posed by the need for structural change.

This is not possible within a national context alone. There is a need to step up international cooperation--particularly among the industries of the European Community by means of the implementation of the appropriate guidelines and projects of common interest.

There are two things needed in order to make full use of information technology--the realization that information technology systems are useful for society on the one hand. To be sure, there is no denying that many information technology systems in their present form are not conducive to fostering this realization. More research and development is required to bring this about. An open debate with interested citizens should also contribute to reducing fear and to a greater understanding and hope for the future in meeting the technological challenge. A climate of public opinion which is hostile toward innovation is no basis for surmounting the structural weaknesses of our country in the information technology field.

On the other hand, to make full use of information technology, there must be the kind of know-how without which the opportunities the technology offers cannot be realized. Since the spread of information technology--especially that of programmable microcomputers as calculators at the workplace or as process controls--will be reaching into virtually every area of activity, the opportunities they offer can only be realized, if many people are capable of working with this equipment and have a clear idea of how it functions. This will also be a job for our educational establishment.

In the government's view, the new information and communication technologies are key technologies which hold out the promise of further growth to the economy. For this reason, industry and science must keep pace with scientific and technological developments and, wherever possible, take the lead.

Economic considerations are in the forefront of the information technology assistance program. But the government is equally committed to the ideal of a society with a human face. The government is also concerned with the qualitative consequences of the use of new technologies which are now beginning to be introduced more and more both in production and in the service industries. The government outlined its position on this issue in its research study entitled "Humanization of the Work Process." The government also has plans for a study on "professional qualifications of women in the introduction of new technologies" for the purpose of forestalling any deterioration in the job opportunities for women.

The supply of information and entertainment materials is growing constantly and, concurrently, the need for the consumer to make a choice also keeps growing.

In this regard, there is a need for strengthening individual responsibility. The growth and the utilization of the new information technology should contribute to an improvement of communication among individuals; to an even wider multiplicity of views within our society; to a strengthening of the freedom of information and opinion and the growth of educational opportunities. The dialogue which the government wishes to conduct with the Laender on the future of the media will take these goals into consideration.

The development and preservation of a free society under the rule of law has a great deal to do with modern information technology. Public administration, public safety as well as the legal system are relying more and more on modern information technology. Further technical developments can help increase the efficiency of government services. Public administration must see to it that utilization of the new technologies will not result in rationalization at the expense of the individual citizen. It is the goal of public administration to establish the proper relationship between efficiency, availability, user compatibility and cost in the utilization of information technology systems.

The government reiterates its obligation to preserve the environment entrusted to us for the coming generations.

There is no more ecologically beneficial technology than information technology. Its use requires few materials and hardly any energy. Information technology makes a substantial contribution to the conservation of energy in home heating, in transportation and in industrial production. Computer models in technology have resulted in major savings in materials and the same may be said of process controls. Other important applications of information technology are in measuring environmental pollution by modern technological means and data processing.

Intelligent use of all these opportunities will help prevent ecological damage which would otherwise occur. At the very least, it results in less environmental strain. Environmental technologies open new markets for the information technology industry.

Securing peace within the framework of the Atlantic Alliance must rely on military means for the foreseeable future. Information technology plays a crucial role in present-day weapons technology. Domestic industry must maintain a high state of technology in this field in order to preserve our future defense capability and the development of defense-optimal weapons and guidance systems.

Despite the substantial pressure of technological and economic competition the German information technology industry has a good starting position it can build on. To catch up, however, there is a need for strengthening and clustering R and D resources and for creating better conditions for the economic application of new information technologies.

In its package of assistance programs for information technology, the government is counting on the innovative capabilities of German industry in the utilization of information technology--particularly in the wide area of technological communications (where it already has a solid base), namely with regard to systems and products for industrial automation; in the construction of energy-saving, ecologically beneficial means of transportation and other innovative high-demand branches of industry whose products and production processes are influenced in major ways by information technology.

These are interdisciplinary measures which focus on five main areas:

1. Improvement of market economy conditions and, as a result, of the competitive position of the FRG and of Europe with special emphasis on venture capital, market openings and innovation-oriented public procurement.

2. Motivating individuals to meet the technological challenge by providing information on options for the future and by intensified education in the information and communication technology field.

3. Activation of innovation-oriented markets by means of a future-oriented buildup of the communication infrastructure and innovation in the end equipment field.

4. Expansion of the technology base to assure the long-term defense capability of the FRG.

5. Intensification and concentration of the FRG research potential in information technology with the aim of developing an R and D capability in the public and private sector commensurate in major respects both qualitatively and quantitatively with the requirements of future international competition.

The government considers the challenges to be met to be the joint responsibility of industry and the government. In this regard, confidence in the adaptability and efficiency of science and industry as well as in social cooperation play a major role.

The government places its trust in the willingness of people to work within a market economy; in the willingness to act as partners by all concerned and in the superior starting position of German industry on the export market.

V. Measures to Support the Development of Microelectronics and Information and Communication Technology

The government now turns to the basic guidelines of its policy and programs as well as to suggestions regarding third-party activities. The government believes that none of the proposed programs individually can result in long-term success but that a cluster of measures must be implemented, if existing lags are to be overcome and a new dynamism in the information technology field in the FRG is to come about. The government is prepared to do its share.

An important condition for success, in the government's view, were the much needed and by now adopted course corrections of basic economic policy and the general rules for assistance to business to develop a dynamics of its own; but the statements to follow will be limited (given the present context) to measures and tasks which are directly related to information technology in the broadest sense--including microelectronics, data processing, communication technology and production automation. Taking the five major areas listed on the preceding pages as our point of departure, the following five sections will deal with five specific measures:

Section V/1 deals with general measures and frameworks for the support of the information technology industry.

Section V/2 explains the government point of view regarding measures, suggestions and tasks designed to deal with information technology at the workplace, in education and in private life.

Section V/3 deals with the subject of technological information, covering the mass media, new forms of business communication and private communication among individuals.

Section V/4 deals with tasks and measures to secure peace which, in the government's view, can be enhanced by progress in the field of information technology.

Section V/5 presents a summary of the decisions the government has taken with regard to future research and technology policy in the information technology field--insofar as these have not been covered in the preceding sections.

V/1 General Conditions

Of all the general conditions, faith in the future of the FRG, in the efficiency of its science community and its industry as well as social cooperation are the most important.

Many countries are looking for fast-working measures to deal with unemployment, improve the trade balance and strengthen their own industries. Because of its short-term success, placing restrictions on world trade is a great temptation, since this helps relieve one's own problems and protects domestic industry. In the information technology field, the partial superiority of American and Japanese firms, coupled with overt or covert government support, vast overproduction and the resultant drop in price all provide obvious pretexts for the introduction of protectionist measures.

1. Free World Trade

The FRG government emphasizes that it is in favor of preserving the concept of free world trade--also as it applies to information technology goods and services.

The government not only is convinced of the power and innovative potential of German industry but also believes in free world trade as a cornerstone of its foreign economic policy.

Innovations in information technology--ranging from microelectronics to data processing and office technology, entertainment electronics, communication technology and industrial automation--all rely on the export market. In foreign countries, German strength in this area of information technology is, if anything, underestimated. The most effective way of countering this impression is for German firms to introduce a strong export orientation. Making use of the means at its disposal, the government will act in support of the reputation of German information technology products and in this way assist the export efforts of German industry in the information technology field.

Successes on the export market cannot easily be attained in the absence of an innovation-oriented domestic market which can be used as a model or test market. Given the large unified markets of the United States and Japan and the enormous R and D expenditures to be incurred by the leading technology producers, the FRG's domestic market does not provide them with a sufficiently large base. The creation of a homogeneous market within the European Community is more important than ever before. This task has been taken up by the EC Commission.

2. European Cooperation

The FRG government supports the aims of the Commission to make the European market for information technology equipment and services more transparent and homogeneous. This also requires more intensive work and cooperation

on the part of the European bureaus of standards. There is a need for removing the many trade obstacles resulting from the different technical specifications established by the member nations.

In addition, the government expressly favors the establishment of guidelines to provide the industries of the member nations with an incentive for closer cooperation, insofar as this is permissible under existing law. In addition, EC assistance measures should be adopted as a means of improving upon the guidelines.

The government therefore also views the ESPRIT program as a useful contribution to stimulating European cooperation and as an important complement to assistance programs on the national level.

In the government's view, liberalization of government procurement markets in Europe in the area of information technology equipment, systems and services would have a faster and more pervasive effect than the ESPRIT program. The government considers education and science of primary importance; also the postal and telecommunications field as well as weapons technology which will be dealt with later. In addition, there are the information technology systems in transportation and public administration. The FRG government agrees with the EC Commission on the fact that technical information is an important element in the future development of society in information technology. The growing use of modern telecommunications technology in the European Community by the telecommunications administrations will result in an improvement of the telecommunications infrastructure.

The government will make an effort to reduce existing surmountable obstacles to innovation in its own country by instituting public sector purchasing procedures more favorable to innovation. A first step in this direction is the impending revision of procurement regulations for services--excluding construction. Since competitive bidding procedures will be retained, there will not be any preference given to innovative procurement; but the new guidelines in their entirety clearly favor innovation and permit more latitude both in inviting bids and in selecting a supplier. Under the revised rules, supplemental bids and/or suggestions for changes may be submitted and these will permit alternative and/or novel technological solutions to affect the procurement process and to be considered as part of it. The preface to the revised rules makes specific mention of the innovative thrust of the document. Another important new feature is the stronger focus on small and medium-sized firms in the letting of contracts.

Innovation-oriented contract procedures, however, confront the supplier with increased demands on the supplier's systems know-how and competency. This calls for further improvement.

3. Innovative Public Procurement Procedures

The government will see to it that the opportunities afforded by the revised rules for innovative procurement are fully utilized. In this connection, it will look for ways of giving support to public suppliers by consulting with them in the appropriate manner.

In its own procurement program, the government will make a point of considering even those smaller but technologically efficient firms which have not as yet been on the market for a long period of time.

It feels there is a need for such pilot procurement programs and will implement them within the framework of the cartel law--in coordination with the Laender and communities, if possible. Some of the developments which may be required in this regard will be supported by the minister for research and technology after conducting spot checks within the context of his programs, taking care that this does not adversely affect competition.

German industry has shown that it can be quite successful in sophisticated technology as long as true competitive conditions prevail--as they do in chemicals, automobiles, electric engineering or in the machine tool and construction industries.

The government will make every effort to strengthen innovation capability and competition in the information technology market. Producers of peripheral equipment which builds on systems other producers have brought out frequently feel that their development operations and opportunities for staying competitive are impaired by the lack of interface standard data regarding new base equipment coming on the market. But if there were a way of coordinating computer and computer-peripheral output of different manufacturers (such as videoscreen or workplace computer procedures), the consumer would be in a position to assemble the equipment that best satisfies his needs by mixing his components. For another thing, the market for end equipment and network concepts would still be open even after a decision concerning the central installation has already been reached.

The government favors the earliest possible publication of interface standards in the interest of guaranteeing a broad-based supply spectrum. It would welcome the widest possible standardization of these interfaces based on an agreement among all concerned. Attention should be paid in public sector procurement programs that the information technology products are equipped with standard interfaces.

4. Opening of Interfaces and Communication Processes

In inviting bids, the government will therefore require that official norms are used in both products and interfaces or that the supplier offer the appropriate interfaces and the appropriate information for connecting and/or coupling them with the products of other manufacturers. Insofar as they represent an economic value, the goods are to be offered at the usual market conditions.

In the final analysis, dynamic development in the information technology field will only occur, if industry is prepared to take risks, to accept structural change and to look for new markets within the framework of a competition-oriented economy. In the information technology industry in particular new advances must be quickly translated into marketable products because of rapid technological change--if markets are to be kept or newly won.

This is not only a question of management; success will also depend on the staff's willingness to change and its readiness to identify with the success of the firm. This is why a climate of partnership should obtain inside the firm as well as the realization that jobs can only be made safe through performance.

Structural change also calls for the establishment and growth of new firms. In the United States, such new firms in the information technology field have made a major contribution to the translation of the technological potential into broad economic success.

The government has therefore decided upon a pilot program fostering the establishment of technology-oriented businesses (TOU) which will provide assistance to private venture capital by the ministry for research and technology. The establishment of new information technology firms will be given special emphasis under this pilot program.

The government has also instructed the minister of finance and the minister for economics to work together with the minister for research and technology in creating better conditions for venture capital and access to the stock market so that young and independent technology firms will be in a better position to obtain capital resources.

The competitive position of the FRG calls for optimal information transfer and among other things, fastest and easiest possible access to available facts and figures. The government is trying to improve on the technical information market--particularly with a view to reducing existing information shortfalls. It supports international cooperation in the technical information field in order to counter potential dependency and vulnerability. The 1985-1988 technical information program spells out the government's views on improving technical information in detail.

V/2 Education and Information

The ability to deal with modern information and communication technologies is assuming more and more importance in view of the growing importance and spread of these technologies into many phases of life and the work process. Success in maintaining the present high standard of living and in attaining as well as permanently securing full employment will depend in large part on the qualifications of the labor force of the future. In this context, education, professional training and continuing education should be viewed as an investment in a secure future.

There are a number of reasons why all sectors of the educational establishment will have to deal with information technology in depth: there is the aim of further reducing heavy physical labor and work hazardous to individual health; there is the transition to electronic controls in production and the adjustment to an environment characterized by an excess of information on the part of a society which does not wish to surrender to the computer but to use it as a means to an end.

Since the use of information technology systems in various phases of life and at the workplace is taking place albeit according to the same basic principles (e.g. digital information display, translation of real processes into machine programmable modes) a systematic introduction into these basic principles at the grade school level would seem to be the best approach. This is also the stage where the broadest possible impact can be made no matter what further education is obtained.

According to the Basic Law, the Laender are responsible for education.

But the government must insist that all young citizens, if possible, are instructed in the future in new findings and skills with respect to information processing systems and that they obtain basic information on their operation and application.

In the early seventies, the Laender began to introduce "informatics" and to develop the appropriate curricula for secondary schools (and gymnasiums in particular). From the outset, the minister for research and technology welcomed and supported this undertaking within the context of the joint education plan. Since 1971, the ministry has supported a total of 54 model programs and made more than DM 26 million or about 50 percent of the total cost available for them.

With regard to the present state of the informatics instruction program, the report of the Permanent Conference of Ministers of Culture of the FRG Laender (KMK) dated 6 May 1983 points out that informatics is being offered at the upper gymnasium level in all Laender and in some of the 9th and 10th forms of the technical high schools but that the courses being given do differ appreciably from Land to Land. The KMK report further states that the urgently needed onward development of informatics education is primarily dependent on teacher training and school purchases of computers.

Rapid improvement in informatics instruction will only be possible, if all the Laender make a determined effort to introduce a continuing teacher training program. Though it is also important to equip the schools with computers, this represents less of a problem than the need for teacher training and the development of curricula. According to the KMK report, the gymnasiums have since attained a minimum level of computer availability--with the Land-to-Land level running between 30 and 80 percent. In the technical high schools, there are far fewer computers--having reached 40 percent only in Bavaria so far--and only a few vocational schools have any computers at all.

Laender plans thus far have aimed at providing a basic course in information at schools which have gymnasium upper forms. In the future, all public secondary school students will have to be instructed in the basic principles of information technology. This is particularly urgent because about 60 percent of any given group leave public school after attaining the first secondary levels nowadays which means that most young people

would not have the chance of getting a systematic introduction to the new inforamtion technologies. Such a "basic course for everyone" would make it possible to learn special skills at some later stage, if needed.

5. General Education

The minister for education and science will make an effort within the framework of the Federal Government-Laender Commission on Education Planning and Research Assistance (BLK) to have the federal government and the Laender work out a plan for the rapid integration of information and communication technology subject matter into general, professional and extra-curricular education based on the BLK target program on "the origins and consequences of structural problems on the relationship between education and employment." The plan is to aim at developing and testing curricula for the integration of information technology into the courses of study pursued by all students of secondary schools of the type I and II: at creating appropriate training and continuing education programs for teachers of all subjects at all schools of the above type and at satisfying the minimum requirements for equipment at these schools.

The minister for research and technology stands ready to make use of the facilities available at major research centers and research societies in order to assist the teachers colleges of the Laender in overcoming the obstacles standing in the way of continuing teacher education as soon as possible.

In this context, the federal government welcomes the announcement by the information technology industry that it will make school computers available free of charge; the offer by the Association of German Computer Centers to provide help to the schools by making some of their professional staff available; the willingness of the Association of German Engineers (VDI) and the Association of Mathematics and Natural Science Instructors (MNFT) to cooperate in the teacher training program and the offer of the Informatics Association (GI) and the Association of Informatics Instructors to take part in continuing education courses at the teachers colleges; to submit suggestions for training curricula and provide the necessary educational materials.

A joint symposium on "Computers and Education" sponsored by the ministry for research and technology and the ministry of education and science affords all those from the fields of technology, business, science, administration, politics and culture an opportunity to get together to find ways of making practical contributions to the rapid and wide-ranging integration of information technology into the educational system. Another symposium, jointly sponsored by the two ministries as well as the Hesse ministry of culture serves the consideration and development of new curricula for secondary schools of type I and II.

During the postwar period, the FRG has been able to build up a successful industrial base because she possessed an outstanding professional education system. Information technology has intensified the trend toward

interdisciplinary demands placed on the training population--among other things with regard to abstract thinking and planning, the ability to communicate and to work as part of a team. In the long term, the skills of the labor force will decide whether full employment and a relatively high standard of living (by the world standard) can be attained and preserved.

Over the past several years, the federal government commissioned a number of studies on the question of which changes in qualifications are made necessary by the broader use of microelectronics. The government will ask the business organizations and labor unions to participate in these studies so that the subsequent implementation of the findings will be easier.

The ministries concerned have joined with the minister for education and science and representatives of business and labor to include the necessary changes in qualification in the standard countrywide training regulations. Insofar as there is a need for research or pilot projects to make a better determination of the required changes, these will be the primary responsibility of the Federal Professional Training Institute. In the "information technology and professional education" field, however, there have been very few pilot projects undertaken thus far.

6. Information Technology and (Initial) Professional Training

In view of the growing importance of the new information technology, the minister for education and science announced in the 1983 professional training report that a new pilot program on "New Technologies in Professional Education" would be undertaken. This program was since initiated in early 1984 and deals, among other things, with the qualification changes in professional training. At an expense of between DM 20 and DM 25 million, it will be possible to give support to some 2,025 projects in factories, inter-factory collaborations, training facilities serving more than one plant and others. In addition, parallel pilot projects have been undertaken at professional schools as part of the BLK assistance program.

It is hoped that these projects will result in compatible and practical solutions which support in a systematic and transparent manner the introduction and spread of information technology throughout the economy from the professional qualification point of view. These findings will also serve to assure the continued development of professional education, including the analysis or revision of existing training programs.

To assure the spread of know-how with regard to the new information technologies and the development of their practical application, training of students in the "informations" field and in electrical engineering disciplines for engineers is of major importance.

The number of students applying for a course of study in informatics has been on the rise over the past several years which is to be welcomed in view of the fact that there is growing need for expertise in this field.

Starting in the winter semester of 1982/83, informatics was therefore integrated into the countrywide distribution pattern of the Central Office for the Allocation of University Admissions (ZVS). The continued rush has since resulted in a debate on whether admissions in this field should be restricted. If this were done, it would, among other things, run counter to the technology policy goals of the federal government. Care must be taken that short-term relief measures do not adversely affect the need for an adequate training capability without any loss of quality of both research and education.

With regard to education in the above disciplines, the government feels it is necessary for students from other technical disciplines as well as non-technical or non-natural science ones to be given an opportunity to acquire the necessary skills for the operation of computers.

The ability to operate a computer--or even to own one which is connected to the university computer center--has since become obligatory at some American universities. In fact, there are very few disciplines in the field of science where this type of equipment is not used.

As things develop further, it will become necessary to provide the universities with a greater number of workplace computers--particularly with a view of instruction in the skills required for the operation of these computers.

7. Universities

The federal government has plans to establish some select local networks of workplace computers for students on a trial basis as part of the "German Research Network" program. Its recommendation is that the institutions of higher learning supported by the various Land governments establish a computer fund to help purchase the required workplace computers which can be borrowed by students for little money and be equipped with software through the university computer center.

Coping with technological change, calls for a more diversified continuing education and reeducation program for those presently employed which takes greater account of information technology. The most important task will be that of continuing education and reeducation at the factory level.

There already are continuing education programs being offered by a great number of public and private educational institutions. Pluralism of institutions and flexibility of continuing education programs being offered constitute the necessary preconditions for an efficient continuing education system.

To effect an improvement of an important aspect of continuing education for professionals, the minister for education and science has given approval to issuing a diploma in economic informatics and established the appropriate

examination procedures. In addition, the Institute for Professional Education has undertaken a large number of research projects to help improve on ways of transferring the new requirements to professional life.

8. Continuing Education

In view of the special needs above all of small and medium-sized firms which require them to train their staff in the operation of information technology, the minister for education and science intends to conduct pilot studies on new programs of continuing education for professionals both in terms of subject matter and procedure. This would include correspondence courses in business operation as well as the increased development of so-called building block courses which would act as separate but interrelated instructional units.

This is meant above all to facilitate and improve upon the obstacles both in terms of distance and time with which small and medium-sized firms are frequently confronted in their efforts to conduct continuing education programs.

The profession-directed and profession-oriented courses offered by the adult education centers will also be expanded; corresponding offerings by the universities may be tested as part of the pilot programs conducted under BLK auspices.

The media can also make a significant contribution (in part by using the new technologies) to overcoming the fear of the unknown computer and helping viewers train on this important technology both at home and at the workplace.

The government therefore welcomes and supports the efforts aimed at developing popular multimedia introductory courses. As far as possible, it will participate in the acquisition of computer hardware and computer programs and support the development of the appropriate supplementary courses at adult education centers and other institutions of continuing education.

The opportunities as well as problems of information technology are the subject of a great many studies and also of public debate. The government welcomes this debate which concerns a technology which has a major impact on the social climate of our time. It wishes to contribute to objectivity on this subject and to counter pessimistic assessments by pursuing a policy which is based on reality and oriented toward the individual.

9. The "1984 and After" International Conference

The government has asked the minister for research and technology to commission studies to look into the effect of information technology the findings of which are to be discussed in late 1984 at a conference entitled "1984 and After."

Changes in working and living conditions as a result of technological developments are viewed in a positive light and accepted by individuals, if the advantage of such change can be appreciated. In view of high unemployment and the rationalization effects resulting from the introduction of information technology, there is a temptation to believe that unemployment could be effectively combated by delaying the introduction of that technology. In principle, however, the majority of the population realizes that the absence of these effects of rationalization would lead not only to a more direct threat to the retention of jobs in export-oriented industries but in the long run also to damage to the economy as a whole and a reduction in the standard of living. To fill the gap between personal experience and a sense for the inner workings of the economy, a wide-ranging information program for factory employees and all citizens is of the essence.

10. Studies and Scientific Analyses of the Impact at the Workplace

The minister for economics, the minister of labor and the minister for research and technology will jointly examine by mid-1984 for which priority areas they should commission studies on the effect of the new information and communication technology at the workplace; which topics should be dealt with as part of the structural analysis report as to determine what effect a more rapid or somewhat slower introduction of these technologies would have on growth and employment in the medium as well as long term.

Rapid introduction of new information and communication technologies and widespread application of microelectronics can help strengthen the international competitive position as well as secure or create jobs in the FRG. It can also help gradually to strengthen threatened branches of industry; but it cannot help solve the underlying problem of unemployment as such.

V/3 Technological Communication

The exchange and distribution of information with the aid of electronic media is of exceptional importance for modern industrial societies. Television, the telephone, off-line data processing, satellites and new communications technology have an impact on human relationships; they are a crucial precondition for the functioning of our modern industrial division of labor societies and are in and of themselves an industry with a great deal of economic dynamism and high technological requirements. Technological communication also includes business and private individual communication as well as forms of mass communication.

The great economic significance of technological communication; its innovative power as well as its significance for the functioning of democracy in the area of the electronic mass media make it appear desirable to try out new forms of communication and to open to new technological developments.

These new forms of technological communication call for joint efforts on the part of administrations, science and industry making use of substantial funds and large staffs.

11. Development Program

The expansion program of the technological communications system will see the German Postal Service work out a medium-term (about 5-year) and a long-range (about 10-year) project for the installation of a digital telecommunications network and the introduction of visual telecommunications. Initially, use will be made of the small band Integrated Service Digital Network presently undergoing international standardization and a correspondingly integrated wide band network which is to serve the needs of individual communication in commercial centers.

To provide inexpensive access to a greater number of radio and television programs and make broadband polling services available, the government will push the construction coaxial cable distribution networks based on demand until economically feasible glass fiber technology becomes available. It will also include the potential of direct-beam radio satellites.

V/3/1 Individual Communication

The basis for the introduction of the Integrated Service Digital Network (ISDN) is the digitalization of the telephone network, including the subscriber connections. The government will see to it that regional aspects are taken into consideration in the introduction of the network.

12. Expansion of the ISDN

The German Postal Service (DBP) expects to start testing the ISDN by 1985 and to have it in operation by 1987--initially in commercial centers. Ten years after its original inauguration at the latest, the ISDN should be available in all areas of the FRG.

The Postal Service will create the conditions for a demand-oriented expansion of the ISDN. Present estimates are that there will be a demand for three to four million ISDN connections by 1995. Both the DBP and industry consider this a realistic figure from a market point of view. These goals will be adjusted every 2 years based on expected trends in demand.

Both domestically and vis-a-vis foreign countries, the Postal Service is responsible for setting the standards which should make communication between any and all subscribers possible in speech, text, data and fixed images.

The strategic goal of the government is the expansion of the present telecommunications network into a broadband switching network with visual transmission technology. To achieve this goal, the DBP will

work out an overall plan. This will take the ISDN concept into consideration in such a way as to permit the installation of an integrated broadband network based on the ISDN.

13. Broadband ISDN and Visual Telecommunications

At the earliest possible opportunity--at the latest within 2 years after the inauguration of the ISDN network--construction will begin on the broadband ISDN based on demand and cost considerations with a view to making broadband services available to most ISDN subscribers by 1995.

Together with industry, the Postal Service will create the necessary conditions for the expansion of this broadband network which takes both the needs of future subscribers and the prospective demand into consideration.

In the long distance network, the introduction of visual telecommunications has already started. It will connect large cities and metropolitan centers throughout the FRG and West Berlin and will be expanded at an accelerated pace over the next 10 years (1985-1995) analogous to a "federal Autobahn network." This network should make possible the transmission of a high volume of smallband services and also connect subscribers (wherever there is a demand for individual broadband communication) with each other.

In addition, broadband connections will in some cases make use of satellites whenever two terminals are not as yet connected via glass fiber cables.

To try out the manifold uses of visual communication technology, the Postal Service is conducting 10 BIGFON experiments at seven locations the results of which are expected to become available between 1985 and 1987. In addition, the DBP will select a number of cities where individual broadband communication is in demand and in these locations begin to plan and build visual transmission lines between local telephone exchanges (analogous to a "city Autobahn"). The connections may lead from the exchange to a given broadband subscriber or conversely from that subscriber to the long distance network and, depending on cost and demand, turn into the basic structure of a new broadband communication network with visual transmission capability by the early nineties.

This program will be subject to review every 2 years and will be adjusted in conformance with trends in demand.

Based on the technological and economic state of glass fiber technology, the German Postal Service will make use of glass fiber technology in its telecommunications network and thus facilitate the gradual transition from copper cables to glass fiber. Within a year, the DBP will work out the appropriate quantitative guidelines.

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The DBP will also be responsible for setting up standards which will apply to any and all subscribers using the broadband ISDN in order to make the proper specifications for the requisite equipment and systems developments available.

In an effort to promote the base technology of the components of visual communication technology, the government plans to make some DM 260 million available for this purpose in the 1984-1988 ministry for research and technology budget.

14. Radiotelephone Service

The German Postal Service will soon be offering a new radiotelephone service which will permit a moving subscriber to be reached automatically through a specified access code and which will enable subscribers to alter radio channels automatically upon leaving the transmission area.

It is the goal of the DBP to create a radiotelephone system in the 900MHz range jointly with other European postal administrations which will provide connections for one million subscribers in the FRG and will make easy access radio telephone service available throughout Europe. Present plans are to inaugurate the service in 1986/87 and to complete the first stage of it by 1990.

In this connection, the ministry for research and technology is providing assistance in the development of a digital radiotelephone system with the possibility of integrating additional radio services.

The DBP sets the interface standards for all public radiotelephone networks and is also collaborating within CEPT on an international codification of these radio interfaces in order to make unrestricted radio telephone service available across national boundaries.

V/3/2 Electronic Mass Media

When the government lifted the ban on cable television in 1979, it paved the way for the construction of a countrywide technological infrastructure for TV distribution networks. The rapid completion of this infrastructure is of special importance in view of the fact that we are far behind some of our European neighbors and the fact that pilot projects offering large numbers of television programs are already under way and that Europe-wide TV programs have begun in 1984 to be regularly broadcast via communications and media satellites. As the distribution networks expand, technical conditions for an improvement in the diversity of opinions in the media are also enhanced.

Based on anticipated demand, the German Postal Service is going on the assumption that some 50 percent of all private households will be able to receive cable TV within the next 5 to 7 years. The demand for cable connections capable of receiving sound and picture is determined--aside from cost--by the number of programs which can be recieved. To bring these programs into the home, the DBP must provide the necessary technical facilities such as radio lines, satellites and satellite receiving stations in time. Added programming, which is an important factor in gaining the acceptance of private households, can be made available in 1984/85 with the aid of telecommunications and broadcast satellites. Further development will depend to a large extent on the Laender's willingness to take part in this important task of building the infrastructure and creating the proper media conditions for it.

15. Broadband Distribution Networks

The government will see to it that the establishment of broadband distribution networks proceeds apace in line with actual demand. The government not only feels it is desirable but also necessary for the population to be provided with the appropriate infrastructure of telecommunications facilities for the distribution of radio and television programs via broadband channel networks based on actual demand. The government thinks it proper that such networks are set up in those Laender, cities or communicites on a priority basis where a demand has actually been found to exist and where the Laender and communicitesmay be counted on to assist in the project. By proceeding in this manner, particular Laender, cities or communities may in fact forge ahead in the establishment of cable networks. The government will try to see to it that cities and communities in more populated areas are not given preferential treatment to the disadvanrage of rural areas. Depending on demand, available funds, profit margins and planning capabilities, DBP annual investment in the construction of broadband distribution networks will range between DM 1 billion and DM 2 billion.

Since the demand for broadband connections primarily lies with private households and reasonable cost is therefore a major consideration, the networks will be using cozxial cables for the foreseeable future. Although these networks already are technically operative and will therefore not result in major technological advances, their establishment is worthwhile from an overall economic point of view provided it proceeds according to actual demand and rentability. At the same time, the expectation is that software and end equipment advances in the electronic entertainment field employing microelectronics will be stepped up. In this respect, the start of cable television has already resulted in the introduction of new generations of equipment and has given an impetus to further development in the end equipment sector.

Once an operational fiber distribution technology is available with a cost benefit ratio equal to that of copper or coaxial cable, that new technology will be used based on anticipated medium-term demand.

16. High-Resolution TV

The government supports the efforts to create the necessary conditions for high-resolution television as soon as possible. The Postal Service will look into the question of how best to transmit high resolution TV, including the possibility of empolying satellite technology. The government proposes to include DM 60 million in the budget of the ministry for research and technology to promote development of this technology between 1984 and 1988.

V/3/3 Monopoly and Competition in Telecommunications

The early planning for the establishment of the ISDN, the introduction of visual telecommunications and the determined efforts of the DBP to set international communications standards as rapidly as possible have all provided industry with a major impulse to develop new types of subscriber end equipment. These will provide the information technology and telecommunications industry with additional opportunities to prepare the market for new offerings in the consumer sector.

17. The End Equipment Market

The DBP will continue to adhere to a liberal licensing policy regarding end equipment and permit all end equipment to be connected to these telecommunications networks which, upon examination, are found to comply with licensing regulations and which can be given proper maintenance.

The government will examine the question of how to guarantee the most liberal conditions for supply and maintenance on future end equipment markets.

The government anticipates intense competition, great innovation and resultant growth in the end equipment sector. In addition, the government will examine the question of what new ways the DBP might find to discharge its responsibilities so as to react more rapidly to technological, economic and political developments.

18. Postal Service/Telecommunications Commission

For this reason, the government will establish a high-level commission including representatives of industry, science and political life which is to prepare a report on these issues by late 1985 which also is to take developments in other countries into consideration.

V/4 Weapons Technology and Safeguarding Peace

The preservation of peace within the framework of the Western defense alliance requires the FRG to have a weapons technology industry which meets her specific interests. In view of the geopolitical situation in Europe, strengthening NATO's conventional defense capability in Europe is a task of overriding importance.

Microelectronics and communication technology play an important role in this context both as regards a weapons technology optimized to meet the FRG's defense needs and the appropriate information collection and control systems with their manifold communications components and alliance-wide integration potential.

In its defense planning, development and procurement, the government is committed to the principle of shared responsibilities and burdens within the Western defense alliance in the sense of close coordination and cooperation because only cooperation will bring down defense costs and make for greater efficiency.

But the government does not look upon cooperation as a one-way street--neither in research and development, nor in the procurement of military equipment. It further believes in the need for an industrial establishment in the FRG which is capable of developing and manufacturing weapons technology systems and the concomitant base technologies which are optimized in terms of modern technology and meet the FRG's defense needs. Industry also needs to have this capability in order to be accepted as a viable partner in cooperative undertakings. Special importance must be attached to close cooperation with suitable partners--particularly with France--in research and development within the context of intensified security policy cooperation.

19. Weapons Technology Research, Development and Procurement

Developments in the field of electronics, the government believes, provide an opportunity for greatly enhancing the Bundeswehr's ability to fulfill its defense mission.

With reference to the Bundeswehr Long-Range Planning Commission's report, the government directs the minister of defense to monitor advances in the field of microelectronics, communication technology and data processing; to take advantage of these in compliance with the needs of the Bundeswehr to dischrage its mission by means of targeted, application-oriented R and D projects and to undertake appropriate efforts of his own in the field of weapons technology research and development to secure the future.

Within the context of the research and technology concept he is to draw up, the minister will collaborate on the appropriate measures with research institutes as well as industry.

Weapons technology research in the communication technology field should be closely coordinated with other ministries--such as the ministry for research and technology and the ministry for post and telecommunications--in order to optimize the use of funds and findings. The minister of defense will therefore be asked by the other ministries to participate in the formulation of specific projects and the resultant tasks so that he can bring his own medium-range and long-range needs to bear on the planning in an interdepartmental fashion.

To assure data privacy both in the transfer of personal data and in the national defense sector, it will be necessary to examine new encoding techniques and to develop them within the context of the new communication services. The government will therefore inaugurate an interdepartmental encoding R and D program and assign the responsibility for it to the minister of defense.

V/5 Research and Technology

The programs listed below are based on the research and technology policy guidelines as outlined by the government in its 1983 annual economic report and in its response on 23 November 1983 to a parliamentary query on "new approaches to FRG research and technology policy." According to these documents, the scope of the funding programs is to become progressively smaller, if at all possible.

In providing assistance in the information technology field, there are two major points to be considered. For one thing, broad-based, indirectly effective measures must be employed to a greater extent than heretofore so as to avoid any infringement of competition and for another thing, the goal is to increase the effectiveness of our limited R and D resources by clustering related R and D activities; by engaging in more cooperation and by improving technology transfer.

The technolgoy assistance program outlined in Chapter V/5/2 focuses on three key areas recognized as such by international experts: electronic components (V/5/2.1); electronic data processing (V/5/2.2) and industrial automation (V/5/2.3).

Within these areas, the required assistance programs for major technologies are listed and explained. Indirectly specific assistance programs will apply in those cases where R and D require broad-based, temporary assistance programs in major technologies based on overall economic considerations. Indirectly specific programs leave it to industry itself to come up with its own solutions for R and D problems.

Assistance programs for combined research projects deal with the kind of research and development which entails risks and high cost and is more than private industry can handle. These are usually long-term projects involving several firms and research institutes. Participation in combined research projects should be open to all interested parties as a matter of principle.

This helps make better use of existing R and D capability and cut down on the previous multitude of individual projects. Through the involvement of interested users, producers, R and D institutions and universities, combined research takes on a less selective aspect.

The determination of funding quotas will primarily be tied to the risks involved in the project. In the area of combined research, the business firms involved will normally be expected to contribute 50 percent of cost. In view of the early marketability of a project receiving indirectly specific assistance, assistance payments are reduced to 40 percent and the program itself strictly limited in time.

Funds for individual programs are part of specific budgets with the possibility of projecting them forward and/or switching them among the various programs.

V/5/1 Research

The growth rate of the FRG's research capability in the field of information technology has been slower than the international average.

In the United States, the government provides funds for a huge research establishment in information technology in industrial laboratories, government research institutes and universities by means of its expenditures for weapons technology research. In addition, there are several large industrial firms in the information technology field which spend their own money on large research laboratories. Bell Laboratories, funded until now from AT&T telephone profits, and the research laboratories of IBM are worthy of special mention in this connection.

In Japan, it is above all the ministry of international trade and industry and the public telecommunications corporation which provide the funds for a very major research effort in the field of information technology. In addition, there are several large, high-profit companies in the information technology field which invest large amounts in long-range research projects.

In Europe, it is above all France which has begun to intensify its reaearch efforts in the information technology field.

Even though the FRG spends large amounts on research both inside and outside industry, we have as yet not fully succeeded in focusing the priorities in the major research institutes and the joint research institutes of the federal government and the Laender on the dynamics of information technology. For another thing, many universities are faced with major equipment shortages as a consequence of the termination of the informatics assistance program. In addition, they do not have enough information technolgoy personnel. Neither of these shortfalls can be remedied by the German Research Association (DFG). Lastly, the profits from the sale of information technology products manufactured by German industry are insufficient--due to the limited domestic market-to cover existing shortfalls from its own capital reserves. Individual efforts by the Laender to help offset this deficit through the establishment or expansion of institutes of their own are to be welcomed in principle but they do pose the danger of tying down scarce staff resources with insufficient financial means.

In the absence of effective research in the field of information technology, however, the long-range competitiveness of our economy may be in danger.

Given this state of affairs, the government sees the need for three programs: intensification of applied research in the preparatory stages of industrial activity--however in close coordination and cooperation with industry; intensification of research at the universities and professional colleges, at major research institutes and at other research institutes jointly funded by the federal government and the Laender, and better utilization of existing resources by means of division of labor, cooperation and communication within the FRG and within the context of the European Community.

Applied research in the preparatory stages of industrial activity is currently being conducted above all as part of the operations of the Society for Mathematics and Data Processing of the Fraunhofer Society and by the Heinrich Hertz Institute Ltd. In addition, there are individual projects going on at several major research centers and universities. There is an almost total lack of research laboratories which might serve as a collection point for researchers from industry, public research institutes and universities who might work together for a time and would see to it that their joint findings were transferred to the various institutions to which they return after completion of the project.

20. Research Infrastructure

The government would therefore welcome and support any effort by industry and the abovementioned research institutes to find mutually acceptable ways of effectively coordinating industrial and public research activities and of assigning joint research teams to specific, temporary projects.

Such an agreement would have to leave the door open for others to join in and would have to be in compliance with anti-cartel legislation.

In addition, such cooperative ventures would provide a great number of opportunities for dialogue between research and industry and among the several firms themselves. They would thus serve as a platform for further cooperation prior to the competitive stage.

Because of the fact that there are a great many universities in the FRG, research in the information technology field is likely to be scattered throughout the country. Cooperation will therefore be synonymous with communication, exchange of research findings and reciprocal utilization of equipment at great distances. As the example of the ARPA network in the United States shows, it is possible to overcome distance and integrate diverse locations through the use of a computer network by research teams.

21. German Research Network (DFN)

The minister for research and technology has inaugurated an assistance program for the development of a "German Research Network" (DFN). The network relies on the public infrastructure (the transmission lines of the German Postal Service); but interfaces must be agreed upon and rules (so-called protocols) must be developed in order to make possible the exchange of information, data, computer software, etc. between different make computers. Subscribers to the network may be research teams at universities, research institutes or in industry and specialized information facilities. Government plans are to provide DM 100 million for DFN development as part of the 1984-1988 budget appropriations.

So as to maintain a solid base in information technology in the nineties as well, it is imperative to conduct basic research in a wide variety of fields. In the government's view, present basic research capability in information technology is inadequate. The German Research Association is currently spending about DM 35 million--or about 4 percent of its aid budget--on this type of research.

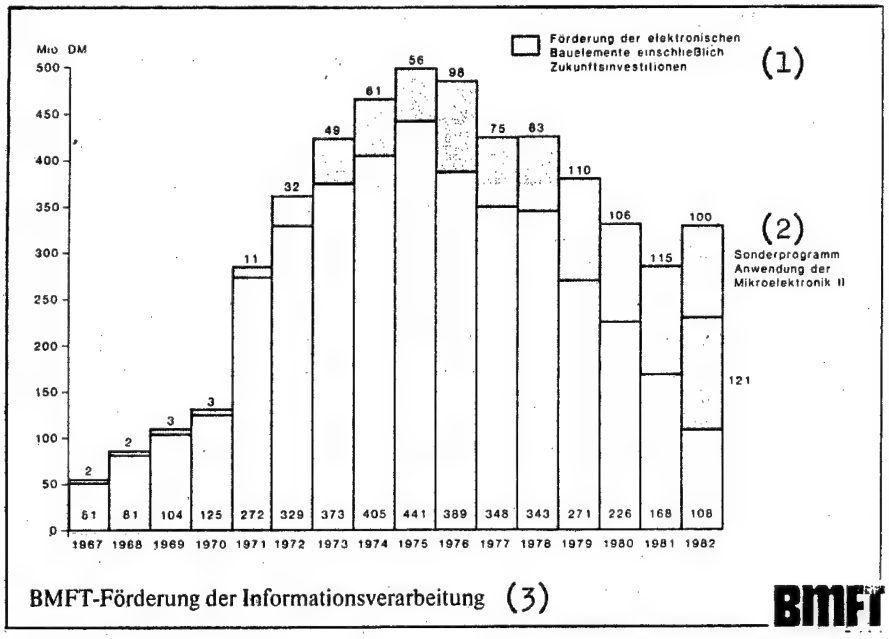
22. Basic Research

The government intends to turn over up to DM 100 million over the next 5 years to the German Research Association for the express purpose of strengthening basic research in information technology with the proviso that the Association, too, expand its activities in this field. The government also suggests that the Max Planck Society increase its research activities in the information technology field. It is furthermore instructing the minister for research and technology to determine whether the Juelich nuclear research facility (KFA) should serve as the hub of a new research center to deal with base technologies in the information technology field by building on the KFA expertise in solid-state physics and acting as a complement to the activities of the GMD [?].

V/5/2 Technology

In 1967, the government began its assistance program in the field of information technology by inaugurating the first data processing program.

Until 1979, a great number of projects--at length costing some DM 350 million each year--were funded to provide assistance in the technology, architecture and application of data processing systems. A study evaluating the data processing program which was prepared by two consulting firms in 1982 found that an underestimation of what is required to make an impact on the market as well as the sometime lack of suitable assistance programs were the main reason why the programs were only partially successful and why the German data processing industry has not yet been able to attain a permanently secure position.



Key: 1. Assistance for electronic components, including future investments.

2. Special program: Microelectronics application II.

3. Ministry for research and technology data processing assistance program.

Following the drastic cuts in the data processing assistance program and its restriction to base-oriented activities, programs in the information technology sector concentrated primarily on securing the technological base in microelectronics and visual telecommunications and on supporting a number of projects dealing with information processing, pattern recognition and software technology using rather modest funds.

In microelectronics, the FRG has by and large been able to maintain its technology base. At any rate, German manufacturers have succeeded in weathering the past component crisis in better shape than most of their foreign competitors. Nonetheless, their sales figures are not big enough to secure them a permanent market position. It is therefore not only for reasons of innovation that a large spectrum of microelectronics products be put to use in the FRG but also because of actual numbers to be produced by domestic industry. To deal with both aspects, a special microelectronics application program to run until 1984 has been instituted which is to have a particular impact on the investment area.

Over the past few years, subsidy programs have helped open up a number of new areas where technological communication may be put to use and where new technologies are transferred into systems such as teletext, text display, BIGFON, automobile emergency broadcast and digital mobile broadcast. In the future, this type of systems development program will be further augmented by even more effective instrumentalities such as the investment program of the German Postal Service. Technological assistance programs will concentrate even more on visual telecommunications. It will be our most important goal to develop this technology further into the technology base of the nineties so as to pave the way for a future-oriented investment program by the German Postal Service. This will call for even more basic research.

In the data processing field, German industry is making a determined effort to take greater advantage of the combination of data processing technology and telematics and the market opportunities resulting from it. The entertainment electronics industry is expected to provide additional incentives for the end equipment market in this field.

German industry will have to cope with three of its major weaknesses: the limited market of the FRG as compared to the United States and Japan; the narrow base in applied research outside of industry itself and the absence of new firms which might take advantage of growth opportunities by turning out innovative products based on existing technology and a functioning venture capital market.

In view of the limited R and D resources available in our country, it is extremely important to achieve greater efficiency of effort on the basis of more intensive cooperation. It is for this reason that the government has focused the assistance programs described below on three major areas and has conceived them in such a manner that research activities may be carried on by several industrial partners and public research institutes simultaneously while their goals and strategies are determined and extrapolated jointly by research, industry and government.

V/5/2.1 Electronic Components

The shortfall in microelectronics production described in Chapter I can only be overcome, if the shortfall in the application of microelectronics is overcome as well. The special microelectronics application program for 1982-1984 on which DM 450 million was spent has managed to set a positive trend in motion. Although it is too early to make predictions regarding the future applications of microelectronics technology in the FRG, it is evident by now that a breakthrough has taken place above all in the capital goods sector. It is in this area, too, that the economic multiplier effect of microelectronics application is particularly noticeable. Just the same, there is a major impasse in this very capital goods sector in that there is a shortage of suitable microelectronics-compatible sensors and actors. This field is of particular interest as well for medium-sized firms working in collaboration with research institutes and universities.

23. Microperipherics Program

The government has instructed the minister for research and technology to set up a microperipherics program. So as to provide for the rapid availability of inexpensive, intelligent, microelectronics-compatible peripheral components (sensors and actors in particular) indirectly specific support is to be extended to appropriate development programs. In addition, joint research institute-cum-industry projects are to create the basic know-how for future-oriented, internationally competitive production plans for such components. The government plans to appropriate DM 320 million for this program between 1985 and 1988.

The application of microelectronics technology in the FRG also depends to a large extent on whether users requiring only a small number of items--as is customary in the capital goods sector--are able to develop systems solutions in collaboration with component manufacturers.

23. Computer Aided Design (CAD) for Integrated Circuits

The minister for research and technology therefore provides assistance to CAD development and consultation on integrated circuits in industry, at universities, at the Fraunhofer Society, the technology center of the German Association of Engineers and the Society for Mathematics and Data Processing as well as the Heinrich Hertz Institute. The government plans to appropriate DM 90 million for this purpose between 1984 and 1988.

The use of microelectronics in the FRG will only become as widespread as in the United States of Japan, however, if the potential users actively take this market over at an early date.

A precondition for this is that the appropriate key components are made available at an early date. These key components must build on new technologies--with systems technology playing a decisive role in this regard. New systems technology concepts such as pipeline structures, array

structures and self-test functions must be analyzed and tested as to their operational possibilities and their impact on processing capacity, testing potential and space requirements. This calls for speculative research and development which involves substantial technological and economic risks.

25. Key Components

To speed up widespread use of microelectronics, the government is instructing the minister for research and technology to provide assistance from his ministry's budget to technology and systems technology projects in selected microelectronic component fields, if these should happen to involve exceptional technological and economic risks. The government will appropriate DM 90 million for this purpose between 1984 and 1988.

The government is proceeding on the assumption that the abovementioned programs in the microelectronics application field will help overcome application shortfalls. The assumption also is that the microelectronics industry will recognize the market opportunities which exist in the FRG and take active advantage of them through the use of appropriate research and development projects and investments.

The ever closer collaboration between users and producers of microelectronics technology occasioned by the systems character of integrated circuits calls for an efficient domestic microelectronics industry. Despite the fact that domestic producers are achieving above-average growth rates on the German market and despite the excellent technological position some of them occupy the industrial base is still too small to make it possible to draw on profits to finance the necessary large-scale industrial research efforts in the microelectronics field. So as not to become second-rate in microelectronics research and in order to be taken seriously as a business partner, there is a need for clustering and division of labor in long-range research with the help of publicly funded research institutes. A basis for this type of approach to research has been developing over the past several years. This basis as well as the willingness to cooperate must be taken advantage of--and the government will do its share to see that this is done.

In order to guarantee basic research in the microelectronics field over the long term, the government will provide assistance in three major areas to develop the basis for new electronic components.

26. Submicronics Project

The government has instructed the minister for research and technology to set up a joint project for the development of submicrone technology with the aim of creating a competitive submicrone technology by the late eighties as well as mass production processes based upon it. Research teams of the Fraunhofer Society and from industry are collaborating closely on this project. The government will allocate DM 600 million for this purpose between 1984 and 1988.

27. New Component Technologies

The government has instructed the minister for research and technology to focus assistance on new component technologies which are not based on the customary silicon base (e.g. new semiconductor materials; development of molecular technology). It is planning to allocate some DM 200 million for R and D between 1984 and 1988--these activities preferably to be undertaken jointly by several research organizations.

28. Integrated Optics

The government has instructed the minister for research and technolgoy to provide assistance to research and development in the integrated optics field. As a first step, a center for integrated optics is already being set up at the Heinrich Hertz Institute in Berlin which will be collaborating closely with other research facilities and with industry on creating a basic design for an optical chip. The government intends to allocate about DM 90 million to integrated optics research between 1984 and 1988.

V/5/2.2 Electronic Data Processing

As a consequence of the integration of data processing, text processing and communication technology and the lower costs and greater efficiency made possible by advances in microelectronics, there are new marketing opportunities for the data processing industry worldwide which to identify and to take advantage of is the job of industry itself.

The government believes there are three areas in which it can contribute to a secure future by providing assistance to research and development projects.

The first area concerns design technology for computer hardware and software. Complex computers and large-scale softward systems can no longer be developed within design and simulation aids. If such design aids can be made available more widely, a substantial multiplier effect is likely to ensue. Public assistance to such projects tied to this condition will help accelerate development of new systems and may be a crucial factor in assuring long-range competitiveness for the German data processing industry.

29. Computer Aided Design (CAD) for Computers and Software

The government has instructed the minister for research and technology to set up a focused assistance program for computer and software CAD's with the aim of providing modern CADs by the late eighties with the help of future-oriented joint research projects. The government intends to allocate some DM 160 million for this purpose between 1984 and 1988.

These funds are to contribute to improving the competitive position of German industry with the help of cooperation and assistance. The high cost of systems required to design large-scale computers would appear to call for European collaboration within the context of the ESPRIT program--the more so, since some of the prospective partners are located in other European countries.

The second area concerns computer design. Conventional computer design capability is beginning to demonstrate more and more serious limitations. Higher computer performance can either be achieved by means of expensive advances in component technology or by means of parallel information processing. The latter calls for different design, i.e. the joint opertion of several computers. For certain tasks, such computers may be optimized to such an extent that they become superior in performance to conventional models. There has already been major progress in research into new problem-oriented computer design. In this field, FRG research teams enjoy a world-wide reputation although industrial application of new computer designs is extremely difficult because of the limited domestic market and the intense competition which forces industry to concentrate. A new assistance program, closely linked to procurement programs in the science and government area, is to contribute to building a bridge between industrial research and potential application in the development of new computer designs.

30. New Computer Designs

The government has instructed the minister for research and technolgoy to set up a special assistance program for new computer design which is to promote the development and production of new computer designs based both on the demand for special computers for scientific purposes and for use in voice and image recognition as well as in information processing. The government intends to allocate some DM 160 million for this project between 1984 and 1988.

The third area concerns information processing and pattern recognition. Over time, according to the experts, three interrelated problems are increasingly coming to the fore in the data processing field: the processing of information in expert systems; voice recognition designed to simplify the man'machine interface and image processing primarily designed to aid quality control in parts manufacture. Using these technologies, the computer turns into an easy-to-use thinking machine. Essentially, this is the goal of the oft-discussed Japanese pfoject to come up with a fifth generation of computers. Because of the FRG's limited resources, the many problems ranging from voice and image recognition to information display and processing must be tackled on a division of labor basis by the research institutes and industry with the aim of translating partial results into industrial applications. To solve the problems involved, the previously mentioned special assistance program for new computer design should provide findings to help create the required hardware technologies.

31. Information Processing and Pattern Recognition

The government has instructed the minister for research and technolgoy to initiate a special assistance program in the information processing field in addition to the programs devoted to voice recognition and image processing. This program is to provide support for joint research projects to help find solutions in the pattern recognition and information processing field. The government intends to allocate some DM 200 million for this purpose between 1984 and 1988.

Only the appropriate programs (software) enable computer hardware to perform specific operations and achieve desired results. Software therefore is an extremely important component of any data processing system the total cost of which is increasingly being determined by the cost of software. Software has become more and more of a bottleneck in the effort to achieve further expansion of data processing systems particularly because an efficient production technology analogous to mechanical production is not yet being employed as widely as would be desirable in the case of software.

32. Software

The government intends to give due consideration to the needs of the software industry by including it in the personnel cost subsidy program the continuation of which the government announced in its 1984 annual economic report. The software industry will be consulted on whether additional funds should be made available to help expand existing R and D staffs.

V/5/2.3 Industrial Automation

The FRG is a world leader in the industrial automation field. Weaknesses in microelectronics application are likely to be overcome as a result of the special microelectronics application program. FRG research institutes are working closely together with industry and enjoy an excellent reputation. At the moment, however, there are three weak points in this field which is of crucial importance for the expert strength of German industry. The government production technology program which has already been adopted will therefore focus on these three areas. The government has allocated a total of DM 530 million for this program which is to run from 1984 to 1987. Deferred funding for projects initiated earlier is contained in the 1988 budget and is part of the total amount.

On the one hand, medium-sized enterprises of the capital goods industry in particular have not as yet taken sufficient advantage of the CAD and CAM potential. But these technologies in particular are of increasing importance for the competitiveness of the production technology industry. If the threshold for the introduction of CAD/CAM systems could be lowered temporarily, there is no reason not to expect a long-range positive impact on the competitive position of this industry.

For this reason, the program provides for financial assistance for the introduction of CAD/CAM systems.

The second weak spot concerns the manufacture of robots. Although robots are in wide use throughout German industry, the industrial base for modern robotics is quite small by comparison. This increases the danger that foreign countries will primarily profit in terms of jobs in the production of robots in an especially dynamic market and that the FRG, for its part, will be taking advantage of the gains in efficiency while suffering the concomitant loss of jobs.

This is why the program is designed to assist in the development of robotics.

The third weak spot concerns the fact that complex systems developments in industrial automation call for expenditures of a magnitude today that individual medium-sized firms can no longer afford. Government-supported industry in the United States, Japan, France and Great Britain is in a position--also because of the support from larger economic units--to carry out long-range projects involving substantial resources.

The program therefore provides for assistance to joint projects based on close cooperation between industry and the research community.

VI. Onward Development

The government knows that the measures outlined in this comprehensive concept cannot be all inclusive given the dynamic rate of progress in information technology. It will therefore be monitoring onward developments in this field very carefully and, if required, decide on additional measures.

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